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A STUDY OF HEAT FLUX INDUCED
DRYOUT IN CAPILLARY GROOVES

THESIS

TIMOTHY J. MURPHY, CAPTAIN, USAF

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THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Astronautical Engineering

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PREFACE

This was a basic study of the behavior of a liquid flowing in small dimension grooves due to a capillary pressure difference while experiencing heat transfer in sufficient quantity to completely evaporate some of the liquid, or dry out a portion of the groove. Obtaining data on the transient response of the liquid front to changes in the rate of energy input to the liquid was of primary interest. I hope this data can be helpful in validating models of the physical phenomena which contribute to the operation of axial groove heat pipes.

While bringing this project to a successful end, I received help from many people. First and foremost, I must thank my thesis advisor, Major Jerry Bowman, for always, and I mean always, being willing to help me. Major Bowman's enthusiasm and keen interest in teaching people to understand were a constant source of strength. His sense of humor blended well with mine and made our discussions enjoyable.

I would also like to the Dr. Elrod and Dr. Franke for being on my committee. Their careful revue of this document and many thoughtful comments are greatly appreciated.

I would also like to thank the laboratory technicians who were so helpful. In particular, Jay Anderson and Andy Pitts were very generous with their technical knowledge and time, and made the long hours of work more tolerable.

Thanks also go to my fellow students and kindred spirits at AFIT for their suggestions and empathy, and to Dr. Jerry Beam from Wright Labs for his sponsorship. I have gained enormous respect for those who do experimental research.

Finally, let me say with great love that I could not have accomplished this project without the care, encouragement, and companionship of my wonderful wife, Maria. I dedicate this work to her and thank her with all my heart.

Timothy J. Murphy

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NOTATION

A_{cx} - Cross Sectional Area

A_{evap} - Area of Evaporator

A_{res} - Area of Reservoir

A_s - Surface Area

$C_{a,s}$ - Molar Concentration on the Surface of Species A

Cp - Specific Heat (J/kg°C)

D_{ab} - Self Diffusion Coefficient

F - Friction Coefficient (See Equation (11))

f - Fanning Friction Factor

FOM - Figure of Merit (See Equation (1))

$h_{c,ave}$ - Average Convective Heat Transfer Coefficient

h_m - Mass Transfer Coefficient

H_{fg} - Latent Heat of Vaporization

K - Wick Permeability

k - Thermal Conductivity (W/m°C)

L_a - Adiabatic Length

L_e - Evaporator Length

L_t - $\frac{1}{2}L_e + L_a$

N_a - Molar Evaporation Rate of Species A

Nu - Nusselt Number

P_c - Capillary Pressure Difference

P_{vap} - Vapor Pressure

P_{liq} - Liquid Pressure

Pr - Prandtl Number

Q_{in} - Heat Transfer into the Evaporator

$Q_{c,max}$ - Capillary Limit Heat Transfer Rate

Q_{out} - Heat Transferred to the Plate While Power Down

R_a - Axial Dimension

R_c - Critical Dimension of the Liquid Surface

R_h - Hydraulic Radius

R_t - Transverse Dimension

Ra_L - Rayleigh Number Based on Length L

Re - Reynolds Number

Sc - Schmidt Number

Sh - Sherwood Number

t - time

T_e - Evaporator Temperature

T_i - Initial Temperature

T_{front} - Temperature at the Front

T_{sur} - Temperature of the Surroundings

V - Velocity (m/s)

Vol - Volume (m3)

WP - Wetted Perimeter

μ - Viscosity

ρ - Density (kg/m3)

σ - Surface Tension (N/m2)

τ - Shear Stress or Thermal Time Constant

θ - Contact Angle

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ABSTRACT

This is an experimental study of ethanol flowing in the narrow grooves of a copper plate which is subjected to heat fluxes sufficient to evaporate more liquid than can be replaced by capillary pumping. Three gıoove geometries are used: square, rectangle, and trapezoid. The objective is to simulate aspects of liquid flow in heat pipes with axial grooves. In order to validate analytical models of capillary flow in grooves, the capillary limit, dryout front location, and dryout front movement in response to power draw downs are documented.

The results show the rewet performance of the groove is dependent on geometry. Grooves of higher heat transfer capacity can be poor for recovering from dryout, like the trapezoidal groove. Comparisons of the theoretical maximum heat transfer with the data are good for the square and rectangle, but overestimate the value for the trapezoid. No theory sufficiently predicted the location of the dryout front for the three geometries. For both a quiescent dryout front and a boiling dryout front, the theory does not utilize an accurate description of the geometry of the liquid front which is critical for determining the capillary pressure difference.

A STUDY OF HEAT FLUX INDUCED DRYOUT IN CAPILLARY GROOVES

I. INTRODUCTION

The development of heat pipe technology is a fairly recent occurrence. It was only 30 years ago that Cotter (Cotter,T., 1965) introduced heat pipes in connection with aerospace applications. Indeed there are many possible uses for heat pipes in space thermal management systems (See Table 1).

Since then, they have been incorporated in such diverse applications as bridge de-icing, arctic tundra solidification, and electronics cooling (Reay, D., 1981:3-73). They are currently being given emphasis as a critical enabling technology for such important programs as the National Aerospace Plane (NASP), and the SP-100 large-scale space power generation nuclear reactor. Heat pipes are attractive for use in spacecraft thermal management and energy production systems for many reasons.

Heat pipes are devices which transport heat from one location to another with a large thermal conductance. This means that they operate nearly isothermally which is an important consideration for space structures. They have no moving parts which increases reliability and eliminates the need for power consumption, maintenance, and active monitoring. Their performance has been verified by long term

TABLE 1

POSSIBLE HEAT PIPE APPLICATIONS ON THE SPACE SHUTTLE

(Towel, 1972;105)

Internal

- Avionics
  - "Black boxes"
    - Aircraft avionics
    - Spacecraft electronics
  - Radar antennae
  - High power wiring and connectors
- Electrical power equipment
  - APU
  - Fuel cells
  - Batteries
- Hydraulic equipment
  - Pumps
  - Hydraulic lines and control valving
  - Actuators
- Environmental control equipment
  - Radiators
  - Heat exchangers
- Main propulsion equipment
  - Gimbal rings
  - Heat exchangers
- Air breathing engine equipment
  - Lubricants
  - Propellant
- Structure
  - Landing gear
  - Engine compartments
  - Wheel wells
  - Pivots and attachments

External

- TPS
  - Aerothermodynamic heating
  - Post-flight soakback
  - Plume impingement
- Environmental
  - Solar radiation
  - Albedo
  - Earth radiation
  - Direct and reflected radiation from other space vehicles

use in space expeditions (Ollendorf, S., et al., 1976:647-649). They are extremely flexible in their design, fabrication, and allowable operating conditions, so that a broad range of geometries and applications can be handled successfully. Best of all, they are simple and lightweight devices.

Heat pipes have their limitations though. It is the purpose of this research to investigate one of the limiting factors in the operation of heat pipes, heat flux induced dryout. In particular, the transient response of evaporating liquid in an axial groove operating near the capillary limit is considered. A flat copper plate with small grooves (0.76 mm wide) of various geometries (square, rectangle, and trapezoid) was heated from below at one end by a resistance heater. The other end of the plate was placed in a reservoir of ethanol, its upper surface flush with the level of the liquid in the reservoir. Capillary action causes the liquid to flow down the grooves to the heated end where the fluid evaporates. Measurements and observations were made and the results are documented in later chapters. It is important to note that this experiment was not an attempt to simulate conditions in a real heat pipe. A more basic study of transient capillary flows in channels was intended. By obtaining success in modeling these simpler phenomena, confidence in understanding and modeling the more complicated heat pipe phenomena will be obtained. An important part of this work is to describe the detailed operation of a heat pipe and point out the ways in which this experiment does and does not simulate heat pipe operation.

Objectives

There are many interesting phenomena associated with the operation of heat pipes: conduction, evaporation, vapor flow, condensation, capillary flow, etc. To achieve reliable, high conductance, compact energy removal, the interrelation between these phenomena must be understood and applied.

Of equal importance, is the ability to use control techniques to optimize the heat pipe performance since weight, surface area, materials, and speed are truly valuable commodities in the space environment. Since this is the case, it is desirable to operate the heat pipe at or near maximum heat transfer conditions.

One of the problems with maximizing the performance is the danger of living on the edge between safe operation and break down. There are several mechanisms which limit the amount of heat flow in certain ranges of operation, e.g. sonic limitations, low temperature friction, film boiling and, of primary interest here, the capillary limit. The capillary limit is the maximum amount of heat transfer which can be achieved by evaporating liquid at a maximum flow rate. This flow rate is due to a pressure gradient which is constrained by capillary and geometrical conditions in the groove.

The overall objective of this experiment was to study the phenomena of heat induced wick dryout, i.e. to observe the transient response of a particular heat transfer experiment, identify the controlling parameters, and document the experimental configuration, the data, and any salient descriptions of the phenomenon in such a way that efforts to model it and validate the model will be facilitated. It is worth reiterating that this was not an attempt to duplicate conditions in an actual heat pipe. Rather, this project was an effort to design an experiment with many of the same critical phenomena as the liquid flow in a heat pipe. By understanding the simpler situation, actual performance of a heat pipe can be successfully modeled. It will be very important to identify parameters which contribute to the transient behaviors of liquids in small dimension grooves as the power levels are increased and decreased about the capillary limit.

By obtaining the objective, the design of wicks, the definition of effective control maneuvers, and the optimization of heat transfer levels can be achieved without undue risk to the spacecraft or mission.

Specific objectives include:

1) Describe the phenomena which contribute to the performance of heat pipes.

2) Design an experiment which allows study of transient capillary flows in small dimension axial grooves;

3) Characterize the attributes of the experimental apparatus

by documenting the physical properties, determining the thermal time constant, and verifying the capillary limit of the groove/liquid combination;

4) Determine the effect of different geometries on the dryout behavior of the groove.

5) Document the location of the dryout front at various power levels and times; and,

6) Document the time it takes to recover from dryout for various values of a step down in power.

Before proceeding with a description of the apparatus, a discussion of the physical parameters which govern the operation of heat pipes in order.

II. DESCRIPTION AND GOVERNING PARAMETERS

Description

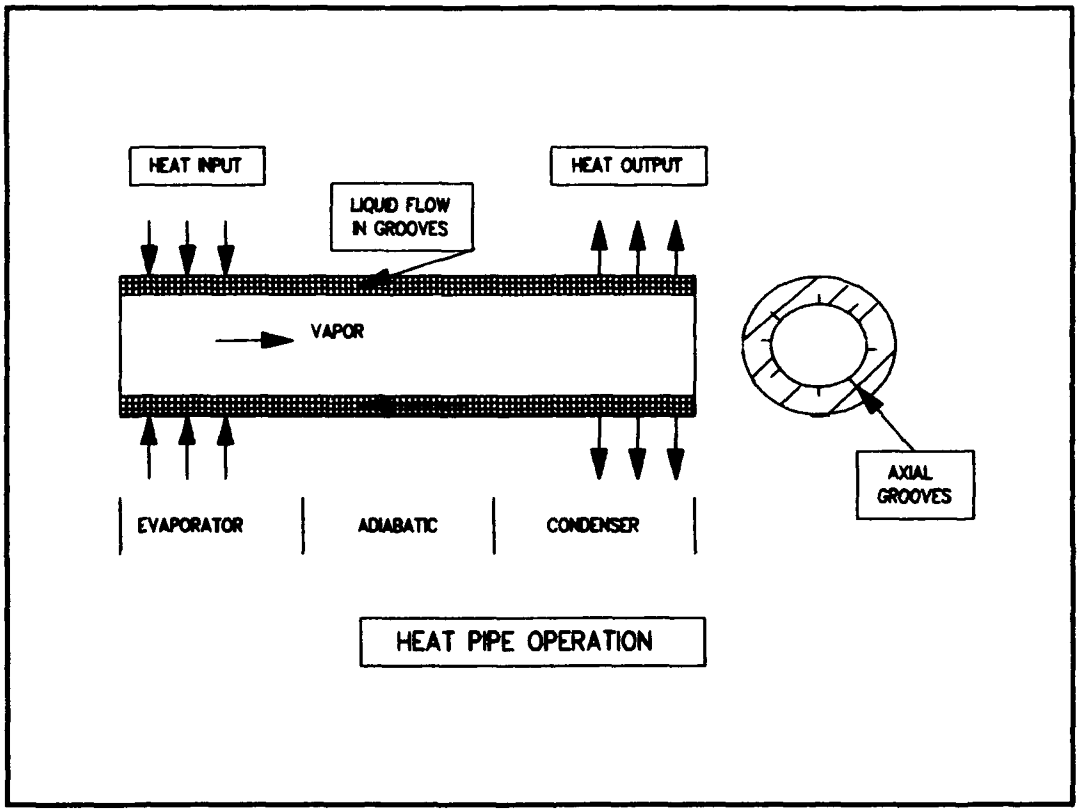

FIGURE 1. HEAT PIPE OPERATION

There are many texts available which discus the operation and physical principles of heat pipes (Chi, S., 1976; Dunn and Reay, 1982; Ivanovskii, et al., 1982; B&K Engineering, 1979.) Heat pipes are usually made of thin-walled, metal tubes which contain a pure fluid in equilibrium with its vapor. The heat source end of the heat pipe is called the evaporator; the heat sink end is called the condenser. Usually there is a section of the heat pipe connecting these two regions called the adiabatic section. (See Figure 1.) Heat is conducted radially through the walls of the evaporator where it vaporizes the liquid in the wick. The vapor fills the center of the tube and migrates up to the condenser where it returns to the liquid phase. Heat is radially conducted through the walls of the condenser where it is rejected by fins or some other radiation heat transfer device. The working fluid is then pumped from the condenser back to the evaporator through a wick which normally lines the inside walls of the tube. The wick has small-dimension grooves or pores (typically in the millimeter range) which allow it to take advantage of capillary action more effectively since the pressure gradient is inversely proportional to the groove or pore size.

In the condenser, fluid collects in the wick along the inside surface of the heat pipe shell and is "pumped" back down through the adiabatic section to the evaporator due to a gradient in pressure between the liquid in the condenser and the liquid in the evaporator. This pressure difference is caused by surface tension. Surface tension at the interface between phases leads to a difference in pressure between the vapor and the liquid. At one end of the pipe, this difference is small. At the other end of the pipe, the difference is

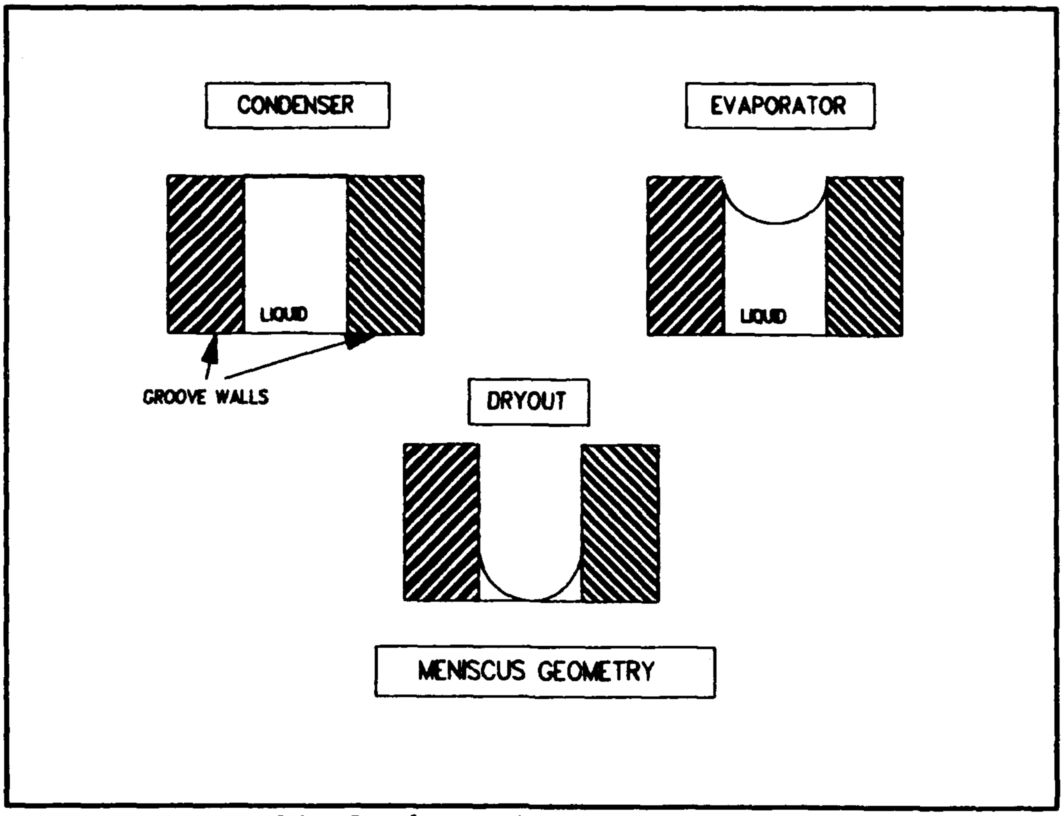

FIGURE 2. MENISCUS GEOMETRY

much larger. Since the vapor pressure stays almost constant along the length of the pipe, the liquid pressure changes significantly. At the condenser, the axial grooves are full of liquid; at the evaporator the meniscus of the fluid recedes into the groove and takes on a smaller radius of curvature. At any point along the tube, the difference between the liquid and vapor pressures is called the capillary pressure difference which is proportional to the magnitude of the surface tension, and inversely proportional to the radius of curvature of the interface between the vapor and the liquid. (See Figure 2.)

Because the vapor and liquid remain near the saturation temperature of the working fluid throughout the axial length of the heat pipe, nearly isothermal conditions exist. This facilitates analysis of heat pipe operation since fluid property changes can be ignored. The small ΔT between the heat source and heat sink also explains the large thermal conductance attributable to heat pipes since conductance is defined as the total heat transfer rate divided by the temperature difference and the area. Finally, the small temperature change along the pipe minimizes thermal stresses in the pipe once steady-state operation is achieved.

Another factor contributing to the high thermal conductance is the change of phase of the working fluid. Utilizing the heat of vaporization allows large amounts of heat to be removed in small areas. And of course, the fluid remains at the saturation temperature during the change of phase. The appropriate choice of working fluid for given operating conditions can be accomplished utilizing a figure of merit (FOM) and other engineering design considerations (Dunn and Reay, 1982:25)

$$FOM=\frac{\rho \sigma H_{fg}}{\mu} \qquad (1)$$

where ρ is the fluid density, σ is the surface tension, H_{lg} is the heat of vaporization, and μ is the viscosity. In Figure 3., the FOM for selected fluids is shown.

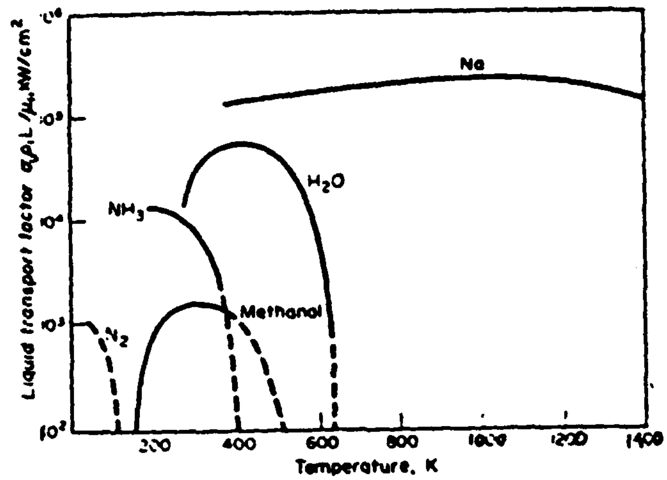

Figure 3. Figure of Merit for Selected Working Fluids (Dunn, P. and D. Reay, 1982:25)

There are three major classes of heat pipes which depend on the temperature range of operation and working fluid: 1) cryogenic or low temperature (0 - 150 K); 2) moderate temperature range (150 - 750 K) which includes water and ethanol; and 3) the high temperature version which utilizes mostly liquid metals such as mercury or sodium (750 - 3000 K).

A feature of heat pipes which makes them particularly appealing for spacecraft use is their high reliability. Unlike many heat exchangers which require a pump to move the working fluid, heat pipes utilize capillary action in the wick to move the fluid over wide ranges of distance, environment and geometry without increasing the complexity of operation. Heat pipes also have the capability for fine tuning and accurate control for use in a wide range of power requirements and temperatures. However, there are limitations which must be considered in application.

The most important of these for space craft power system utilization is the capillary pumping limit since minimizing size and weight is a goal. The wick geometry/solid-liquid interface characteristics can only provide so much fluid return to the evaporator before dryout occurs. Dryout is defined as that situation when liquid no longer wets the entire groove. At low heat fluxes, the depression of the meniscus in the evaporator is small and it is easy to replenish the evaporated fluid. At higher rates of heat flux, the meniscus radius of curvature gets smaller and smaller until it reaches the characteristic dimension of the groove or pore. At this point, the pressure gradient between the condenser and evaporator is maximized, and therefore, so is the amount of fluid which can be moved to replenish that which has been evaporated. Consequently, if the heat input to the pipe is increased further, the liquid front (extent of liquid in the groove) begins to recede back up the groove toward the condenser and the wick dries out. This may cause a rapid increase in temperature in the materials of the heat pipe and can lead to catastrophic failu: : if measures are not taken quickly to rewet the wick or reduce (power down) the heat load. Unlike a heat pipe, the groove in this experiment was so much smaller than the copper plate that natural convection dominated heat transfer from the plate. Although dryout was accomplished by increasing the heat flux to the plate, the temperatures in the evaporator region remained fairly constant since evaporation of liquid was not the major cooling mechanism for the plate.

Governing Phenomena

A number of important physical phenomena contribute to the successful operation of a heat pipe.

Capillary Pressure.

Capillary action is the source of the pressure gradient which causes the liquid in the condenser to flow back to the evaporator. Surface tension is caused by the particles in one phase or substance having a stronger attraction to the other particles in that same phase or substance than to molecules in some other phase or substance (Adam, N., 1968:Ch 1.) For example, liquid water molecules are more strongly attracted to each other than to water vapor which can be treated as a weakly interacting perfect gas. This imbalance in forces causes a surface tension at the interface between the phases, leading, for example, to a liquid drop taking on a spherical shape when suspended freely in air. The capillary pressure P_c can be written

$$P_c = 2\sigma\cos\theta\left(\frac{1}{R_t} + \frac{1}{R_a}\right) \tag{2}$$

where σ is the so called surface tension and R_t and R_a are the radius of curvature in the transverse and axial direction respectively. In the case of a long thin groove, the axial radius of curvature can be taken to be infinite, and the equation reduces to

$$P_c = \frac{2\sigma\cos\theta}{R_t} \tag{3}$$

The transverse radius of curvature for a groove full flush to the top with liquid is also infinite, hence the capillary pressure difference is zero in this situation. But as the meniscus begins to recede down into the groove, the pressure difference between the liquid and vapor grows as the radius of curvature becomes finite and then small. A point is reached where the meniscus can shrink no more. This point is called the critical radius of curvature, R_c. It is usually a significant dimension of the capillary structure, e.g. the radius of a pore or the width of a flow channel (Chi, S., 1976:35.) The maximum capillary pumping occurs at the critical radius of curvature. At any location along the pipe, a pressure balance can be written between the liquid and vapor

$$P_{vap}(x) - P_{liq}(x) = P_c(x) \tag{4}$$

In the condenser, the grooves are mostly full of liquid (in fact, there may be a puddle which has a negative radius of curvature), and for all intents and purposes, the pressure in the vapor and the pressure in the liquid are the same ($R_t = \infty$.) In the evaporator, however, the meniscus recedes into the groove, hence the radius of curvature begins to get smaller, and a capillary pressure difference develops between the liquid and the vapor. In the limit, the meniscus completely recedes into the groove; the radius of curvature takes on half the dimension of the groove; and the maximum capillary pressure difference for pumping the liquid obtains. Since no further increase in capillary pumping can occur, this defines a limitation on the operation of the heat pipe called the capillary limit.

The surface tension is also described as the free energy per unit surface area change. At the interface between a solid, a liquid, and a gas, the liquid surface can take on different geometrical shapes based on the relative attractions between the molecules in each phase. The final shape of the solid-liquid-vapor interface is determined by an equilibrium between the forces between the various phases (Ivanovskii, et al., 1982:20). Another important parameter can be defined called the contact angle, θ. The contact angle is an indication of the ability of the particular fluid to wet the solid. Small contact angles (i.e. near zero) are desirable for wetting. (See Figure 4.)

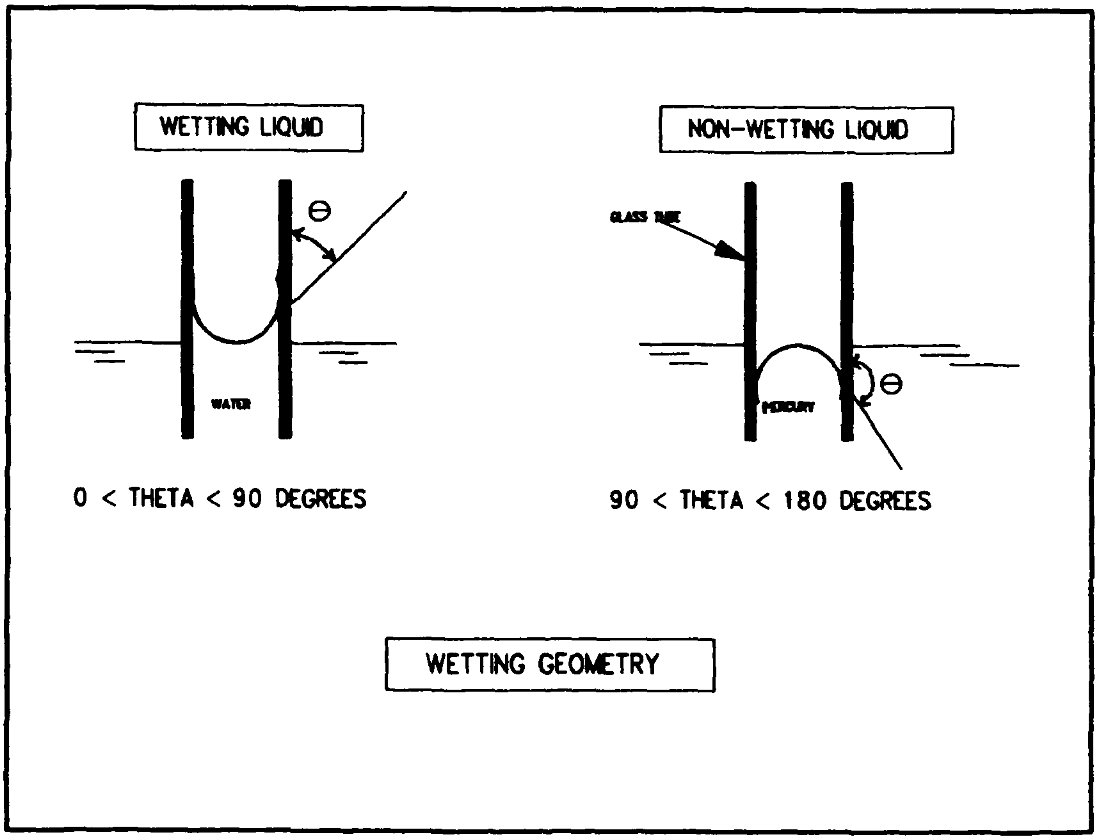

Figure 4. Contact Angle

Much of the activity of the interfacial attraction between the solid and fluid phases is due to microscopic phenomena in a very small layer near the surface of the interface, perhaps only one molecular diameter in size (Adam, N., 1968:5.) Consequently, one would expect that the phenomena of surface interactions would be important for predicting how the working fluid would react when it encounters a capillary passageway, although this behavior is still not well understood (de Genne, P., 1985:828.) In fact it has been shown that the physical properties of a thin film of liquid on a metal surface are different than that of the bulk of the fluid (de Genne,P., 1985:838.) These property differences lead to the presence of pressure gradients (disjoining pressure) which ultimately cause the fluid to flow in a particular direction although no other surface or body forces are present to cause flow.

The classic cases are water or mercury in a reservoir into which a capillary tube is placed. Since water wets the glass, the meniscus rises in the tube. Conversely, mercury does not wet glass and the meniscus recedes down into the tube. (See Figure 4.)

Factors Affecting Surface Tension on a Liquid Surface.

1) Presence of impurities -- Adsorption which is the assimilation of a gas or vapor at the surface of the fluid can cause reduction in the value of the surface tension σ. Impurities in an otherwise pure fluid tend to have a

significant effect on surface tension because they tend to congregate in the surface layer which as explained above is the pertinent action zone for surface tension. Disrupting the thin surface layer with impurities significantly reduces the surface tension (Adam, N., 1968:130.) Great care is taken when fabricating heat pipes in an effort to eliminate surface impurities.

2) In general, the surface temperature has a negative effect on the value of σ, i.e. $d\sigma/dT$ is negative. This would seem to work against the operation of a heat pipe since it is necessary for the value of the capillary pressure difference to be higher in the evaporator than in the condenser for the heat pipe to work. Additionally, the gradient in σ with respect to temperature is larger at higher temperatures (Rohsenow and Choi, 1961:Fig E.2.) This may contribute in some way to the difficulties encountered when trying to rewet a wick after dryout, but heat pipes usually have a very small temperature gradient between the condenser and evaporator under normal operating conditions.

However, a much more significant factor in developing the pressure gradient in the liquid is the change in the radius of curvature between infinity in the condenser to a small dimension of the groove in the evaporator.

3) Changes in the vapor pressure of the liquid also contribute to changes in surface tension. There is a large

amount of molecular activity at the vapor/liquid interface where both evaporation and condensation occur (Adam, N., 1968:6.) The large number of particles achieving sufficient energy to leave the surface of the liquid cause almost continuous redistribution of the particles at the surface. Surface tension is a manifestation of the attraction imbalance the particles in the surface layer have for the particles in the interior of the liquid versus the particles in the vapor above or the solid beside the liquid. Since surface tension is manifested in a very thin layer near the surface of the liquid, one would expect considerable interference due to mass flow by evaporating or condensing vapor. (See item 2 above on temperature effects which indicates how a fluid nearing the boiling point has a large reduction in surface tension.)

4) Finally, the wettability of the solid wick is reflected in the contact angle. Contact angles between zero and ninety degrees signify a fluid which wets the surface. Contact angles greater than ninety degrees signify a nonwetting surface. (See Figure 4.) The aim in heat pipe design is to choose a fluid and wick material combination which has a contact angle near zero degrees. Factors affecting θ, the contact angle include:

a) Surface roughness

b) Chemical contaminants in the solid

c) Solutes in the liquid

d) Temperature.

Although in the manufacture of heat pipes great care is taken to avoid impurities, the axial groove used in this experiment was "of stable dirtiness", i.e. the groove was cleaned before each run but no extraordinary efforts were made to maintain a perfectly clean surface, i.e. free of surface impurities such as oxides. This approach was taken in the hope a stable configuration obtained so that changes in surface conditions did not contribute to changes in operating conditions which might affect the transient behavior.

Heat Transfer Phenomena.

There are numerous factors which control heat transfer at a surface. In a heat pipe, phase change, conduction, convection and, to a lesser extent radiation, all contribute to the successful operation. A number of papers have been written which address the effect of heat transfer to a thin film with respect to dryout and rewet (Stroes, et al., 1990; Iloeje, et al., 1982; Ueda, et al., 1983; Zuber and Staub, 1966; Orell and Bankoff, 1971.) A summary of important considerations follows.

Phase Change.

In equilibrium, the same amount of evaporation and condensation occurs between stable phases of a pure fluid at all times. Normally, as the temperature increases, the amount of evaporation exceeds the amount of condensation and a net loss of liquid occurs. As the temperature difference between a surface and the fluid increases, the amount of heat transferred to the fluid increases. A point is reached where a large increase in heat transfer is achieved with only a small temperature increase. This is called the boiling point. In a heat pipe operating at low heat fluxes, evaporation occurs at the liquid/vapor interface due to heat conducted across the liquid in the wick from the hot walls of the pipe. As the heat flux is increased, a critical point is reached where nucleate boiling begins.

As the heat flux is increased further, a transition to film-boiling occurs. This can be an unstable regime, and always involves a large temperature difference between the metal surface and the fluid. Lack of contact between the tube surface and the liquid in the wicks is undesirable since instabilities in the geometry of the meniscus disturb the capillary pumping. Some authors conjecture that the dryout front is defined at the point where stable film boiling occurs (Peng and Peterson, 1991). However, dryout can occur without any boiling at all if the groove is small enough and the evaporation rate of the liquid is large enough to overcome the replacement of fluid due to capillary pumping.

In any case, at the dryout front in a groove, boiling is a common phenomena. Some parameters which influence boiling include:

a) Existence of nucleations sites which helps reduce the amount of superheat necessary for boiling initiation.

b) Bubble formation which is better on non-wetting surfaces than on wetting surfaces. As the heat flux increases, bubbles form at the heating surface which can rapidly increase the heat transfer due to the latent heat of evaporation carried by the vapor in the bubbles and also by the increased circulation caused by the motion of the bubbles.

c) At low heat fluxes, evaporation occurs at the surface of the liquid. Natural convection currents can help to increase the heat convected to the surface.

d) At high temperature differences between the heating surface and the fluid, film boiling may occur which causes the temperature of the heating surface to increase rapidly. The onset of this film boiling becomes stable at a temperature known as the Liedenfrost Temperature (Karlekar, B. and R. Desmond, 1982:678.)

e) Of course, once boiling begins, large amounts of heat transfer can be accomplished by fluids which have a large latent heat of evaporation. This is reflected in the heat pipe figure of merit for fluids mentioned above.

f) There are certain hysteresis effects which must be considered. For example, with sodium in stainless steel pipes, (Schins, H., 1973) because of good wettability, nucleation was hard to initiate, and 100 degrees of superheat was necessary to get boiling. Once it began though, the surface was "conditioned" and only 20 degrees of superheat was necessary to achieve boiling. (This is the opposite of the expected behavior.)

g) The type, size, and number of nucleation sites on the heating surface control the ease with which nucleation can occur. It is possible that oxidation or other surface reactions could provide a plethora of nucleation sites, but as mentioned above, great care is normally taken to maintain a clean surface for capillary reasons.

<u>Conduction.</u>

Conduction, although a necessary mechanism for transferring heat into the evaporator and out of the condenser, is normally not a controlling phenomena for normal steady-state operation in heat pipes. The well-known Fourier's Law of Heat Conduction is applicable.

$$Qin=-k\frac{\partial T}{\partial r}|_{sur} \tag{5}$$

where Q_{in} is the heat flow to the pipe, T is the wall temperature, r is the radius of the pipe, and k is the thermal conductivity of the pipe material.

Axially conducted heat transfer in the liquid, vapor, or along the pipe walls is ignored in comparison to the phase change and the conduction in the normal direction, although recent studies have found a contributing influence to overall heat pipe performance due to axial conduction (Kuramae and Matsumoto, 1985:84-99.) At the dryout front, conduction of heat from the region ahead of the front is an important contributor to determining the temperature rise in the groove where no liquid remains. Consequently, conduction is important for determining the time it will take to achieve a high enough temperature to cause failure of seals or rupture of the heat pipe walls. It also affects the time for dryout conditions to disappear after a reduction in power input (power down) has occurred.

<u>Convection.</u>

In heat pipes, heat transfer by convection is limited to the removal of vapor from the evaporator and transportation to the condenser where its latent heat is rejected. There may also be some external contributions to energy supply or rejection but they are not considered here. Convection is more prominent for this project since the hot copper plate sat in quiescent air where natural convection currents cooled it. In fact, this is the predominant cooling mechanism for the grooved plate since the amount of liquid in the grooves is so small that evaporation, even at the maximum rate, was not large compared to the energy removed from the thermal mass of the copper plate due to natural convection.

Radiation.

Radiation is also limited in applications to heat pipes. It is normally associated with providing the energy to the evaporator or carrying energy away from the condenser on the exterior of the pipe. Analysis of heat pipe performance usually ignores radiation due to the nearly isothermal conditions which prevail along the pipe. In this experiment, radiation contributed to energy losses from the heater.

Transient Phenomena.

Under normal steady state operations, the vapor flows to the condenser and then returns to the evaporator through the grooves in the wick. As surface temperatures or power levels into the evaporator increase, more and more fluid is evaporated requiring more and more pumping from the wick in order to replace it.

A condition is reached where the wick dries out (the capillary limit). Temperatures in the dried out portion of the evaporator increase greatly. Unless these temperatures are reduced quickly, large thermal stresses are induced in the heat pipe which could cause seal rupture, loss of fluid, or even fusion of the metal.

Since working near the maximum heat flux to optimize heat pipe performance is common, transients in power levels could ultimately cause failure of the mission and/or even loss of a spacecraft. Recovery from dryout is not as simple as just turning off the power until things cool down a bit and then restarting the heat pipe again. Recent experiences with heat pipes have found that once dryout occurs, rewetting of the wick is sometimes difficult to achieve.

Exactly how dryout occurs, and what processes lead to rewetting the surface after dryout, still requires further explanation. Observing the phenomena is made difficult by the small dimensions of the grooves, the evaporation of the liquid, the high temperatures in the vicinity of the dryout front, and the complicated geometry at the liquid/vapor/solid interface which is controlled by wetting and surface tension phenomena.

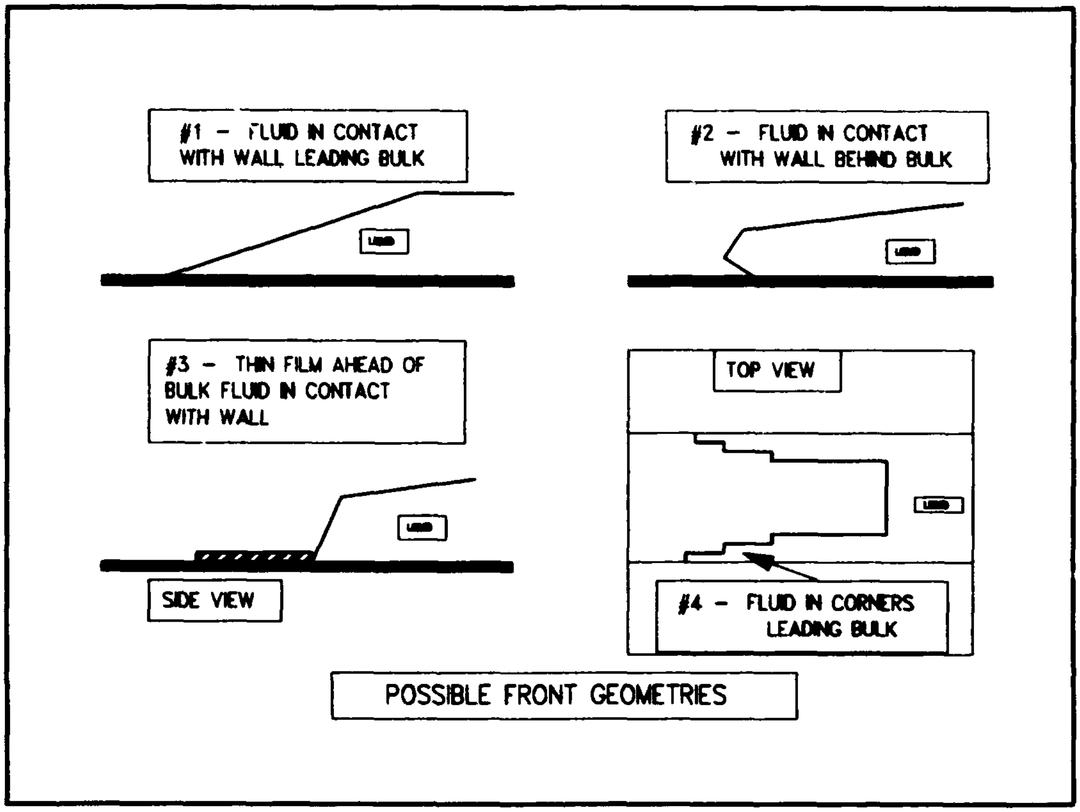

FIGURE 5. POSSIBLE FRONT GEOMETRIES

Some possible dryout scenarios are depicted in Figure 5. The fluid in the groove retreats back down toward the cooler condenser end with a velocity known as the dryout front velocity. Two competing phenomena define this dryout front velocity. First, the evaporation rate of the liquid which causes the front to retreat back down toward the condenser; and second, the pressure gradient which pumps liquid toward the evaporator. The shape of the meniscus at the end of the liquid is a critical controlling factor. If the liquid is stretched out into a thin film, the properties may be different than the bulk of the saturated fluid as discussed earlier. But how are the properties determined? If film boiling or nucleate boiling occurs, how is the liquid front shape determined? Just what are the conditions at the dryout front? Some authors have speculated that the dryout front is defined where the Liedenfrost temperature, or stable film boiling temperature, is achieved (Peng, X., and G. Peterson, 1991:3.) Does a stable front exist at all?

It is common in transient heat transfer problems to consider the heat capacity of the medium to be a controlling influence on the time constant for the thermal response. A possible scenario for rewetting is that the fluid at the front must cool down the groove wall sufficiently to allow further advance of the liquid. What length of solid which constitutes the groove and tube wall must be cooled and to what temperature must it be cooled before fluid can flow once again? It is possible that the appropriate temperature is defined by a certain specific dryout front geometry, either one with the fluid near the wall advancing in front of the rest of the fluid (Figure 5. Case #3), or the liquid higher up in the groove advancing ahead of the fluid near the wall (Figure 5. Case #2.) It is also possible that some evaporation rate other than that defined by film boiling (Liedenfrost) may be the actual condition.

Other possible considerations for determining the dryout front location are the effect of two phase conditions and temperature on the physical properties of the solid, liquid, and gas. It is not hard to imagine the surface tension, the contact angle, the fluid viscosity, and even the electrochemical surface properties of the solid, are significantly affected by the presents of a two phase fluid and large differences in temperature (recall the steep temperature gradient at the dryout front.)

A physical model which completely describes the phenomena of dryout and rewet in the groove of a heat pipe has yet to be established (Stroes, G., et al., 1990:359-364.) Without such a model, efforts to ameliorate the deleterious effects of dryout by optimizing geometries, power downs, etc., cannot be effectively applied.

If the temperature of the heat pipe surface is the major determining factor of the rewet phenomena, then the thermal capacitance of the solid metal will be the dominant factor in the transient response. In this experiment, the mass of the copper plate was very much larger than the mass of evaporating liquid, and natural convection dominated its cooling rate. Consequently, the value of the thermal time constant which is a measure of how rapidly steady-state is achieved after a transient, is almost entirely determined by the physical properties of the copper plate. In a heat pipe, optimal performance is achieved with a charge of liquid approximately equal to the volume of the grooves which is small compared to the total inner volume of the pipe (pipe inner diameters are centimeters across.), or the volume of the metal pipe. This is sufficient liquid to assist in cooling the metal pipe though, hence the time constant will be lower than for the case where natural convection is the only cooling mechanism.

Fluid Mechanics.

While the fluid mechanics of heat pipes can be very complicated, particularly for transient behavior, recent analytical work has shown that simplifying assumptions are adequate to obtain reasonable results (Ambrose, et al., 1991:532-538; Ambrose, et al., 1990:222-227; Kuramae, M., 1970:102-106.) This topic is normally bifurcated into a discussion of liquid and vapor flows.

Liquid Flow.

Considering the liquids normally employed and the low velocities achieved by the liquids during operation, the flow is very well modeled as a laminar, incompressible fluid. The inertial terms are small, so that the pressure gradient is limited to overcoming the shear stress between the liquid and the wick. A one-dimensional treatment is usually adequate at steady-state conditions, but the phenomena of dryout is inherently two-dimensional, at least in the area of the dryout front. If a sintered or mesh wick is employed, Darcy's equation for flow is normally applied (Bird, et al., 1960:150) which is a momentum balance relating the superficial velocity of the fluid in a porous medium to the permeability of the medium and the gradients in pressure through the medium.

Vapor Flow.

A range of treatments for the vapor portion of the flow has found successful results. For steady-state situations, a one-dimensional, perfect gas, incompressible flow model is common. For transient studies, normally a two-dimensional, perfect gas, compressible flow model is employed; but, a one-dimensional, saturated vapor, compressible in time, incompressible in space treatment has also given satisfactory results while saving considerable computer time for its calculations (Bowman, W., 1991:374-379; Bowman, et al., 1992:571-574.)

There are two other limitations for heat pipe operation which are related to vapor flow: 1) the entrainment limit, and 2) the sonic limit. The entrainment limit occurs when the velocity of the vapor is so great that the shear stress developed between it and the counter flowing liquid cannot be overcome by the capillary head, and the liquid is prevented from returning to the evaporator. The sonic limitation occurs in cryogenic heat pipes or during start-up of heat pipes which have become very cold due to storage in outer space. The vapor density is very low and therefore, high velocities are required to get even a modest performance. But, the sonic velocity ($a = (\gamma RT)^{\frac{1}{2}}$) of the vapor is low due to the low temperatures and so the flow quickly becomes choked. Neither of these limitations will be addressed in this work and, indeed, the experimental set-up is a flat plate in open air, which means there will be no counter flowing vapor with which to contend, and the temperature is well above the cryogenic range. They are included here for completeness.

Groove Geometry.

Besides the working fluid, and the tube for containment, the only other significant piece of hardware (or the significant piece of hardware), is the wick. The purpose of the wick is two fold. First, the wick provides the narrow channels which, in combination with the properties of the liquid, cause the capillary pressure difference between the liquid and the vapor and leads to the pumping of liquid from the condenser to the evaporator. Second, the wick actually provides the conduit for the liquid flow, and in this capacity, is the source of shear stress which the capillary pumping must overcome.

These two purposes can compete with one another during the design of the wick. On the one hand, smaller channels lead to higher capillary pressures differences; on the other hand, the smaller channels are associated with higher velocities and higher shear stresses which tend to reduce the pumping capability. The ratio of surface area to volume for most grooves is inversely proportional to the width of the groove. Hence, the smaller the groove width, the larger the area is for shear stress in comparison to the area for liquid flow. In an effort to ameliorate this competition, and in order to optimize performance, a very large number of wick designs has emerged (See Figure 6.)

The first category of wicks is a simple mesh. Normally, the wire mesh screens are wrapped into layers and put in contact with the walls of the tube. Akin to the mesh in performance is the sintered wick which is made by pressing small particles of metal into the desired tubular shape. Both of these porous wicks have received considerable attention and application (Pruzan, et al., 1990:1417-1426). Their biggest problem,

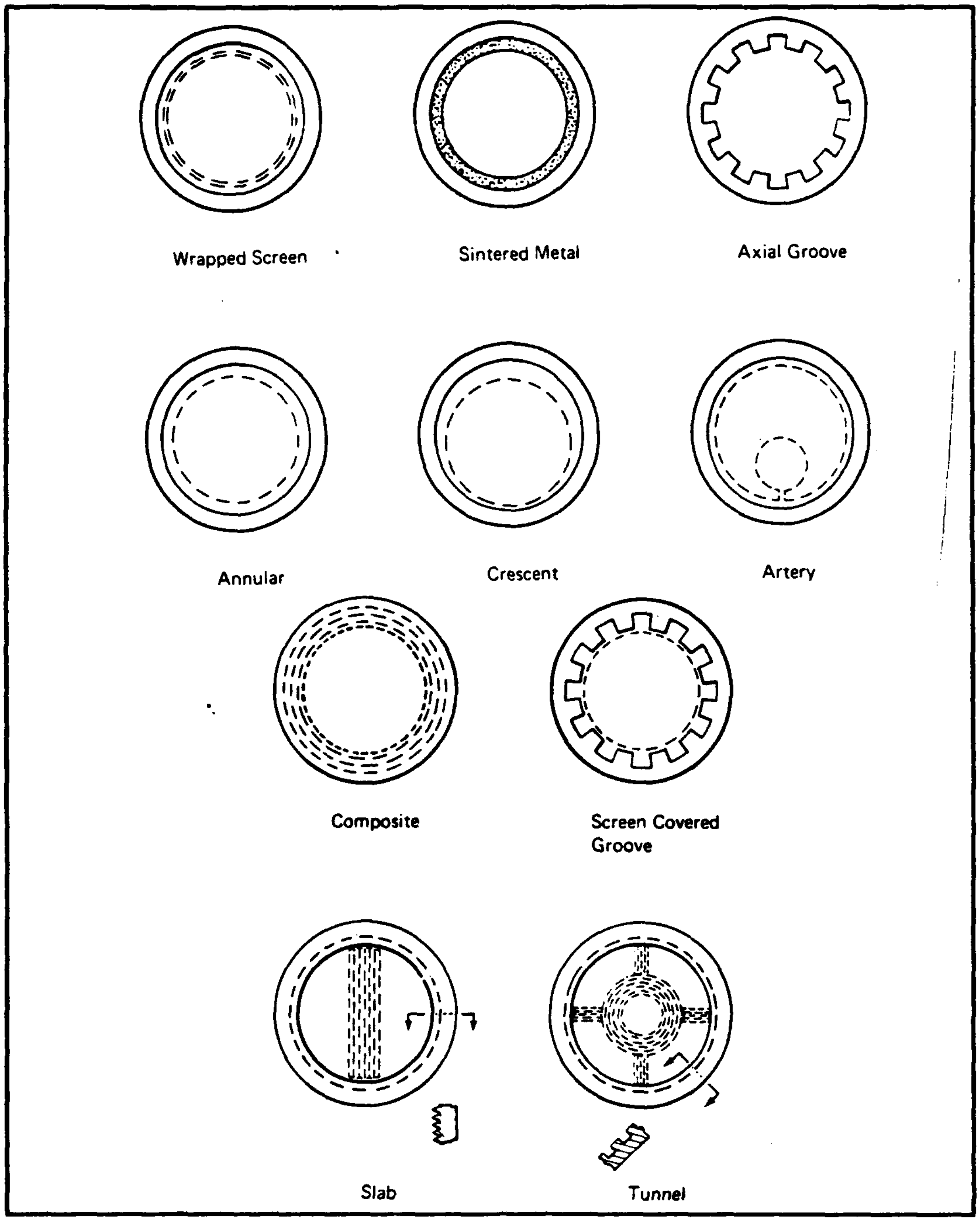

FIGURE 6. WICK GEOMETRIES
(Chi, S., 1976:6-7)

besides being difficult to model, is the small channel geometries and the large resistance to liquid flow.

The next category is axial grooves (Brennan, et al., 1976: 4-22; Harwell, et al., 1977: 131-147; Jang, J., 1990:1-6; Kamotani, Y., 1976:83-91; Kosowski and Kosson, 1971:417-429.) These come in a wide variety of shapes from rectangles of varying aspect ratio, to triangular, circular, and finally the dovetail variety (trapezoid) which is commonly the result of extrusion. Axially grooved pipes are easily manufactured by extrusion processes. They are much more amenable to modeling and experimental research because one can see what is happening in the grooves during operation. They suffer from a lower capillary capability due to the larger channel dimensions, but they are also much less resistant to the flow of the liquid.

The third category of wicks includes the hybrid and miscellaneous varieties. These are attempts to combine the concepts of the first two categories in an attempt to optimize performance. Most notable is the artery type. Here, a larger dimension conduit for liquid flow is in close proximity to a smaller dimension channel responsible for generating the capillary pressure difference between the vapor and the liquid.

During this experiment, the axially grooved type wick of various geometries will be studied. An attempt is made to determine the geometrical configuration of the groove which can contribute to avoiding dryout, or just as importantly, to recovering from it.

Now that the first objective has been achieved, i.e. an exposition of the important factors influencing the dryout behavior of capillary grooves in heat pipes, theoretical considerations will be presented to lay the groundwork for calculations and results in later chapters.

III. THEORY

The theory used in describing this experiment is simple for two reasons. First, the macroscopic concepts of fluid flow in a channel heated from beneath are straightforward. Secondly, microscopic details about the phenomena underlying capillary flows are lacking (Peng, et al., 1990: Stroes, et al., 1990). Described below are the concepts and calculations used to discuss the procedure and results of this experiment in later chapters.

Capillary Limit

As described in chapter one, there is a limit to the amount of heat which can be removed from an axial groove without dryout due to the inability of the pumping mechanism to replace the evaporated fluid. A simplified analysis which follows the development in Chi (1976:Ch 2) arrives at a relation between the properties of the groove, the liquid, and a constant heat input, which can be used to determine the capillary limit.

The difference in pressure at any point along the heat pipe is just equal to the capillary pressure difference (See Equation (3).) In this experiment, there is no counterflow of vapor, so the vapor pressure is replaced by a constant pressure due to the air in the laboratory at atmospheric conditions, with a contribution from the evaporating vapor. Consequently, the pressure drop between the liquid in the condenser and the liquid in the evaporator section is a balance between three factors: 1) the capillary pressure difference; 2) the pressure drop due to viscous forces which act on the fluid as it flows through the groove; and 3) the pressure drop due to a gravity gradient, either positive or negative, in the direction of liquid travel. Included in this last aspect is any hydrostatic head which may exist in the condenser due to a puddle, or for the purposes of this project, due to the liquid level in the reservoir being higher than the top surface of the plate. Hydrostatic head will be ignored since pains were taken in the experimental set-up to minimize its effect (the maximum groove depth is less than 3 mm and the overflow from the lower reservoir was adjusted so that the fluid level in the reservoir was only about one millimeter above the top surface of the plate.) While the original intention was to make the experimental apparatus capable of operating at various orientations with respect to the gravity vector, only a zero angle of inclination is considered in all that follows. Time and structural problems prevented investigating angular dependence.

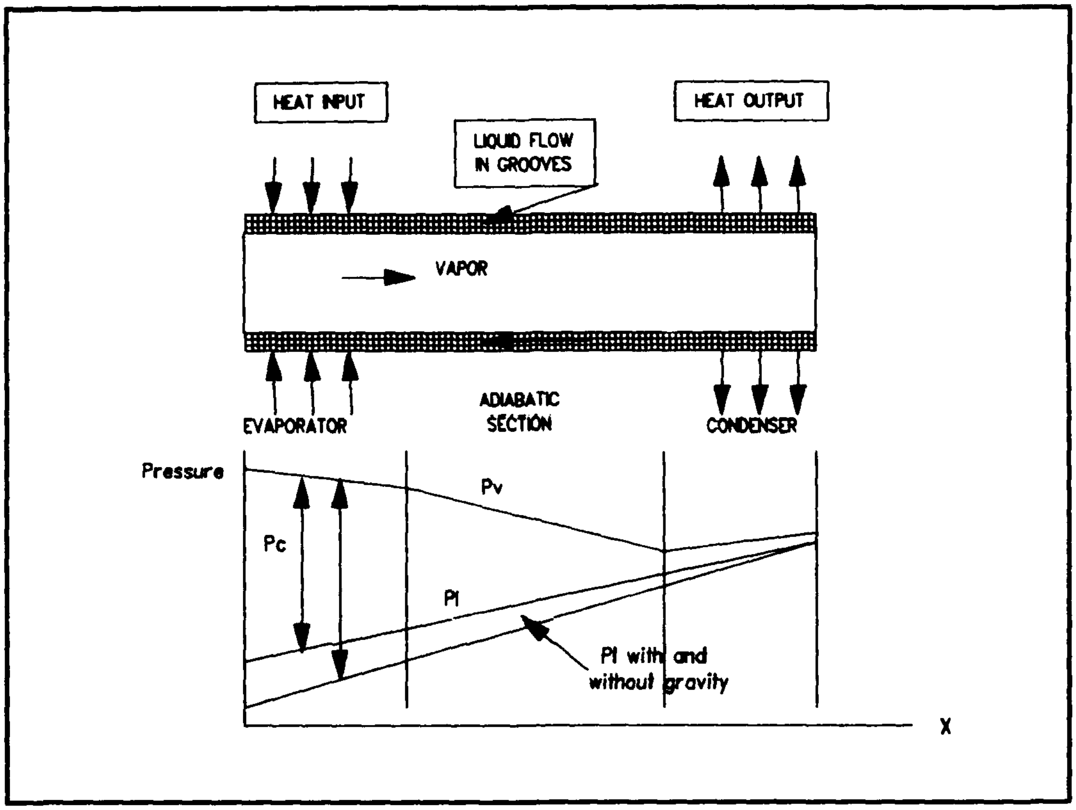

FIGURE 7. PRESSURE DROP ALONG HEAT PIPE

The pressure balance then involves only the viscous forces and the capillary pumping. In Chapter I the maximum capillary pressure difference was written

$$P_c = \frac{2 \cdot \sigma}{R_c} \qquad (3)$$

in which R_c is a characteristic dimension of the groove. To get the capillary limit, or maximum pumping rate for a certain length of tube, the maximum capillary pressure difference which occurs at the minimum critical dimension must just balance the frictional forces in the same length of tube

$$P_{c,max}=\Delta P_{liq} \tag{6}$$

For a semi-circular groove, the $R_{c,min}$ is just the radius (Chi, S., 1976:35.) For a square or rectangular groove with a closed end, the minimum R_c (max P_c) is just the width of the groove. For grooves with odd geometries, for example a trapezoid, the $R_{c,min}$ may change from time to time depending on the point of contact for the liquid meniscus. For example, in a trapezoid, the critical dimension may be the open top of the groove until the fluid breaks away from the top and recedes down into the corners of the groove. (See Figure 8.)

All of the above has been for a closed ended groove. For open ended grooves of all types, there are additional considerations. The literature suggests using the hydraulic radius, R_h, as the critical dimension (B&K Heat Pipe Design Handbook, 1979:119.) The hydraulic radius is defined as twice the cross sectional area for flow divided by the wetted perimeter. This view will be utilized in later data analysis in cases where the dryout front has receded significantly from the end of the groove. This approach would also be used if the groove is so long that the frictional losses outweigh the capillary and gravitational pumping ability causing the liquid to stop before reaching the end of the groove. Since the

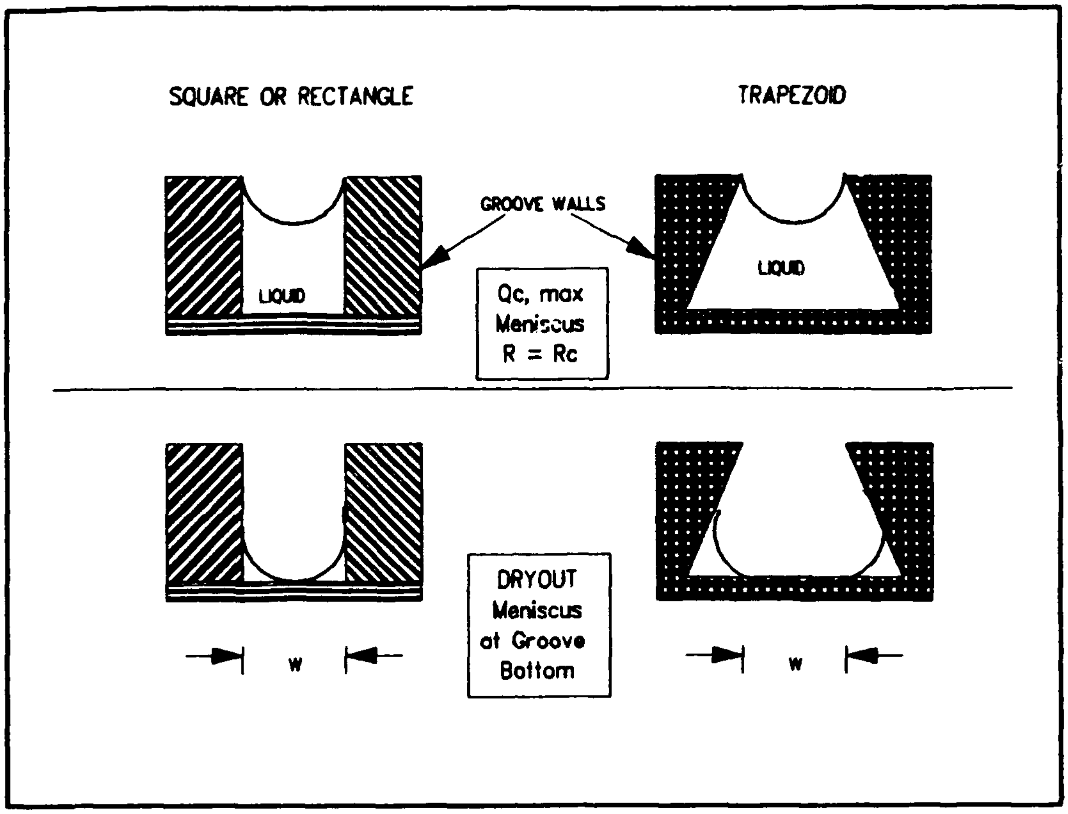

FIGURE 8. MENISCUS RECEDING INTO GROOVES

liquid does not see a groove end in this case, it is called the open ended theory. It is not clear that using the hydraulic radius to artificially increase the pressure drop between the dryout point and the condenser is justified. The data obtained in this experiment will be compared to both the closed ended theory and the open ended theory for validation.

The pressure drop due to viscous forces can be written

$$\frac{dP}{dx}\Big|_{liq} = -\frac{2\tau}{R_h} \qquad (7)$$

where τ is the shear stress. The friction factor is used to relate τ to the velocity

$$\tau = f * \frac{\rho V^2}{2} \tag{8}$$

The friction factor for laminar flow in channels can be related to the Reynolds number, Re = $\rho V(2*R_h)/\mu$, where V is the velocity, ρ is the liquid density, μ is the liquid viscosity, and R_h is the hydraulic radius. The local fluid velocity can be determined by considering the heat input to the fluid from a given location x to the end of the evaporator

$$Q_{liq}(x) = \rho V(x) A_{cx} H_{fg} \tag{9}$$

where $Q_{liq}(x)$ is the heat input to the liquid up to some location x, A_{cx} is the wick cross-sectional area and H_{fg} is the latent heat of vaporization of the fluid. Combing these equations gives

$$\frac{dP}{dx} = -\frac{(fRe\mu)}{2\rho A_{cx} R_h^2 H_{fg}} Q_{liq}(x) \tag{10}$$

Next, define a friction coefficient

$$F = \frac{\mu}{K\rho A_{cx} H_{fg}} \tag{11}$$

where K, the wick permeability, equals $2*R_h^2/(f*Re)$. Note that

K is a property of the groove. Since for laminar flow, f is related to the Re by a constant, K is proportional to the square of the hydraulic radius. For square and rectangular grooves, this constant of proportionality is related to the aspect ratios of the groove given in Figure 9. For trapezoidal channels, Rohsenow and Choi (1961:63) suggest f=16/Re where Re is based on the hydraulic radius.

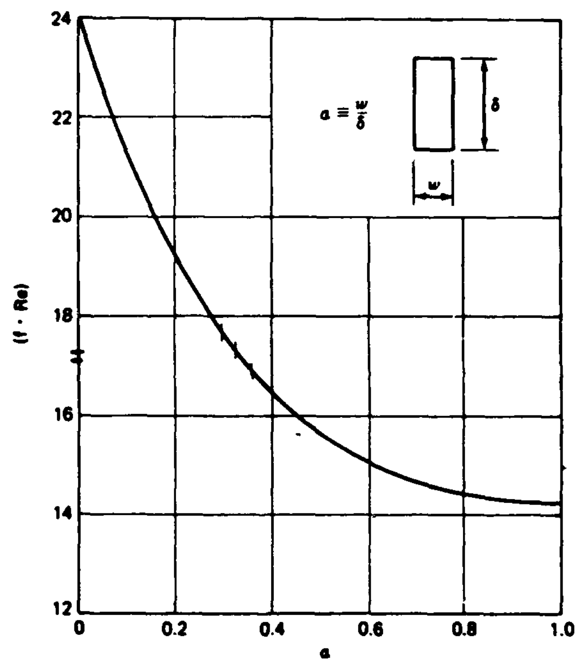

FIGURE 9. CONSTANT RELATING f AND Re FOR LAMINAR FLOW IN RECTANGULAR CHANNELS
(Chi, S., 1976:40)

With these definitions, the pressure drop can be written

$$\frac{dP}{dx} = -F * Q_{liq}(x) \qquad (12)$$

This equation can be integrated between the end of the evaporator and the condenser to get the total pressure drop which must equal the maximum capillary pumping capability. Note that the pressure in the liquid decreases from the end of the evaporator ($x = 0$), to the end of the condenser ($x = L$.) If the temperature of the liquid is fairly constant throughout the length of the groove, F will remain constant. The only thing left to do is define $Q_{liq}(x)$.

Since $Q_{liq}(x)$ is the total heat into the pipe, and since the heat input is assumed constant throughout the evaporator, the dependence of $Q_{liq}(x)$ on x is as follows:

For $0 < x < L_e$, $Q_{liq}(x) = Q_{c,max} * (x/L_e)$

For $L_e < x < L$, $Q_{liq}(x) = Q_{c,max}$

where L_e is the length of the evaporator, L is the total length of the groove (for this project $L_e + L_a$), and the case under consideration is the maximum heat capacity, $Q_{c,max}$. Multiplying both sides of Equation (12) by dx and integrating gives

$$\Delta P_{liq} = F \int_0^L Q_{liq}(x)\, dx = 2 \frac{\sigma}{R_c} \qquad (13)$$

The integral of $Q_{liq}(x)$ along the pipe is $(L_e/2 + L_a)Q_{c,max}$. Therefore

$$Q_{c,max} = \frac{2\sigma}{FR_c\left(\frac{L_e}{2}+L_a\right)} \tag{14}$$

In Chapter V, this equation is used to compare the predicted performance of the three grooves used in this experiment and the measured $Q_{c,max}$.

Convection Heat Transfer Coefficient from the Grooved Plate

A simplified energy balance for the grooved plate used during the experiment without liquid in the groove is used to determine an average convective heat transfer coefficient. This heat transfer coefficient is then used to check the energy flows when evaporation of liquid is occurring. The material properties for the 99.9% copper plate are assumed constant. In applying conservation of energy to the grooved plate, only three contributions to the steady state energy balance are considered: 1) energy inflow from the heater on the bottom side of the plate, 2) energy conducted from the hot end of the plate to the room temperature liquid in the lower reservoir, and 3) an "effective" heat convection term which includes losses due not only to convection from the hot plate, but also radiation from the heater and conduction from the lower side of the plate. In the unheated portion of the plate, only conduction is considered.

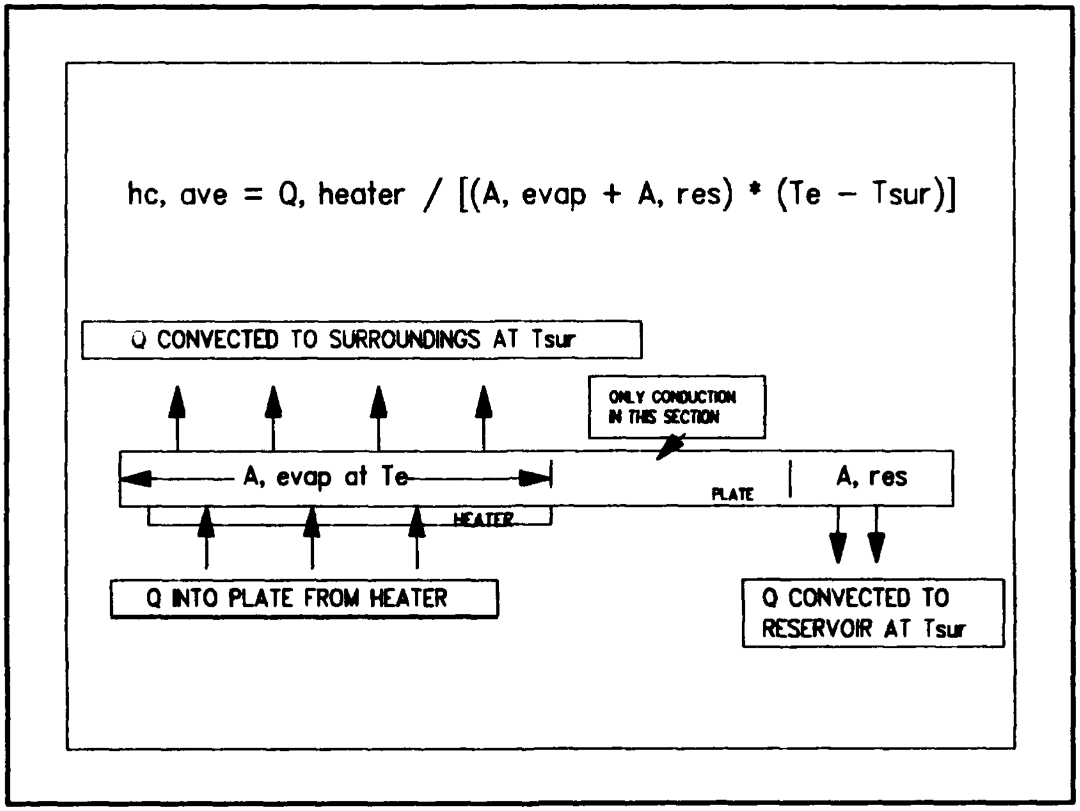

FIGURE 10. PLATE ENERGY FLOWS

An overall energy balance for the plate evaporator section can be written $Q_{in} = Q_{out}$ where Q_{out} consists of an average heat transfer coefficient which includes natural convection and the heat conducted to the reservoir which is also approximately at T_{sur}. Thus, the heat transfer coefficient can be written

$$h_{c,ave} = \frac{Q_{in}}{(T_e - T_{sur})(A_{evap} + A_{res})} \tag{15}$$

where T_e is the average temperature in the evaporator, T_{sur} is the temperature of the surroundings, A_{evap} is the area of the plate above the evaporator, and A_{res} is the area of the plate in contact with the liquid in the lower reservoir.

During an experiment, T_e and T_{sur} can be measured, and $h_{c,ave}$ can be determined readily. The experiment can then be repeated with fluid in the grooves. Heat is input to the plate until the same temperature profile in attained. The difference in heat input between the dry groove case and the wet groove case should be balanced by the mass rate of evaporation times the latent heat of evaporation for the fluid. This is discussed further in Chapter V.

This value for the heat transfer coefficient is only approximate. It is useful in estimating energy loss from the plate by means other than evaporation. Estimating energy losses can be used in conjunction with thermal time constant and mass diffusion calculations to make conclusions about the quality of the experimental results (See Chapter V.)

It seems appropriate to make the following note here. There is one term which does not appear in either section of this chapter so far. The liquid in the lower reservoir is basically at room temperature. By the time it is pumped up to the evaporator, it is at a somewhat higher temperature, in some cases at its saturation temperature for one atmosphere. The heater must not only provide the energy required to evaporate the liquid, but it also must provide the energy to raise the fluid temperature from ambient up to the condition in the evaporator. The maximum measured value of Cp ΔT is very small compared to $Q_{c,max}$, so it does not significantly affect the results, and it is ignored from now on.

Evaporation

In all of the experimental runs, dryout occurred before the onset of boiling. The evaporation of the liquid in the groove is spread out over the total area of the fluid in the evaporator section up to the dryout location. As a check on the measurement of the heat transfer to the fluid in this situation (i.e. the evaporation rate), the analogy between heat and mass transfer is invoked. Since the mass transfer in this experiment is diffusion-limited, i.e. there is no bulk movement of vapor, the mechanisms which control the diffusion of heat and mass are identical if certain dimensionless similarity variables are the same. The following development parallels that in Incropera and DeWitt (1991:Ch 6.)

The liquid is assumed to be at the temperature of the plate in the evaporator section. A mass transfer coefficient, h_m, can be defined

$$N_a = h_m A (C_{a,s} - C_{a,sur}) \tag{16}$$

where N_a is the molar evaporation rate of species a, A is the surface area, and $C_{a,s}$ and $C_{a,sur}$ are the molar concentrations of species a in gmoles/m^3 at the surface and in the surrounding air respectively. This equation is immediately recognizable as of the same form as the equation which defines the heat transfer coefficient

$$Q = h_c A (T_s - T_{sur}) \tag{17}$$

where Q is the heat transfer rate, h_c is the convective heat transfer coefficient, and T is the temperature. The differential equations which describe the transfer of mass and heat due to a gradient in concentration or temperature respectively, are identical if the Reynold's numbers are the same, and the value of the Schmidt and Prandtl numbers are equal. Consequently, the solutions are the same. This means the Nusselt number, Nu, and Sherwood number, Sh, have the same functional form. If the heat transfer coefficient is known, the mass transfer coefficient can be determined. This can be demonstrated as follows. If the form of the Nusselt number is known

$$Nu = fn(L, Re)\, Pr^{n} \tag{18}$$

then,

$$Nu = fn(L, Re) * Pr^{n} = fn(L, Re) * Sc^{n} = Sh \tag{19}$$

where L is a significant dimension of the plate; the Prandtl number, Pr, is $Cp*\mu/k$; and the Schmidt number, Sc, is $\mu/\rho*D_{ab}$. D_{ab} is the self-diffusion coefficient of the liquid vapor in the surrounding air, and k is the thermal conductivity. Then

$$\frac{Nu}{Pr^{n}} = \frac{h_c L}{k} Pr^{-n} = \frac{h_m * L}{D_{ab}} Sc^{-n} = \frac{Sh}{Pr^{n}} \tag{20}$$

Rearranging,

$$\frac{h_c}{h_m} = \rho Cp Le^{1-n} \tag{21}$$

where ρ is the density, Cp is the specific heat, and Le is the Lewis number which is defined as $k/\rho*Cp*D_{ab}$. For most applications, the value of the coefficient is taken to be $n = 1/3$.

The convective heat transfer coefficient used in the equation above is different than the average heat transfer equation defined in the previous section. The difference is that one is based purely on the diffusion of heat from a hot surface in still air, while the other is a catchall device for summarizing the losses from the plate from mechanisms other than natural convection. To determine a h_c for use in the mass transfer analogy, McAdams (1954:Ch 7) suggests the following for natural convection from a horizontal, hot plate

$$Nu_{L,ave}=0.54*Ra_L^{1/4} \tag{22}$$

for $10^4 > Ra_L > 10^7$ where Nu_L,ave = h_c*L/k, and the Rayleigh number, Ra_L, is the product of the Prandtl number and the Grashof number, Gr_L, which is an important dimensionless parameter for natural convection. A modification suggested by *Lloyd and Moran* (1974) is to define the significant length dimension as L = A/P where A is the surface area for heat transfer and P is the perimeter of that area. Using equation (22) in equation (21), h_m can be found. The amount of energy which goes into evaporating the liquid can then be found utilizing equation (16) for the molar diffusion rate and multiplying by the molecular weight and the latent heat of evaporation

$$Q_{evap}=N_a M_a H_{fg} \tag{23}$$

The value of the molar concentration at the surface is defined by the partial pressure and temperature of the liquid vapor considered as a perfect gas. The molar concentration in the surroundings is assumed to equal zero.

Thermal Time Constant

If the lumped capacitance assumption is invoked (Incropera and de Witt, 1985:177), an energy balance which equates the rate of change in internal energy of an object to the rate of heat transfer to the surroundings, leads to a relationship between temperature and time for the case where a hot plate is immersed in an isothermal medium with heat transfer coefficient h_c.

$$-h_c A_s (T-T_{sur}) = \rho Vol Cp \frac{dT}{dt} \tag{24}$$

The result is of the form

$$\frac{T-T_{sur}}{T_i-T_{sur}} = e^{-\frac{t}{\tau}} \tag{25}$$

where T_i is the initial temperature and τ is the thermal time constant which is the time it takes the plate to reach 63% of the total temperature difference between T_i and T_{sur}. τ can also be shown to equal ρVolCp / h_cA_s (Incropera, F., and D. DeWitt, 1985:176.) Since the temperatures and material properties are known for the plate in this experiment, the thermal time constant can be used to characterize the plate and as a check on the consistency of the experimental results. If Q to the plate is not zero but constant, the results are changed. A particular solution to the differential equation must be added to the homogeneous solution and the results is

$$\frac{T-T_{sur}}{T_i-T_{sur}}=e^{-\frac{t}{\tau}}+\frac{Q}{h_c*A_s*(T_i-T_{sur})}(1-e^{-\frac{t}{\tau}}) \tag{26}$$

IV. EXPERIMENTAL APPARATUS AND PROCEDURE

In this chapter, the details of the experimental apparatus and the procedure used to collect the data are described. This is only a listing of the pieces of equipment and specific measurements obtained. All discussions about the significance of the results are left to Chapter V.

Description

The apparatus used for this experiment was designed to be simple and yet capture the essence of the physical phenomena. Some features included in this description were not needed in the final experimental runs because time or experience precluded their use. The dimensions and other characteristics of the equipment were originally chosen for use with water. Water inconsistently wetted the copper plate, hence a change to ethanol (C_2H_5OH) as the working fluid was made.

Figure 11. shows the experimental set-up. The numbers in the figure refer to the items listed in Table 2. Ethanol is placed in an upper reservoir (2) from whence it flows through a calibrated flowmeter (4) to a lower reservoir (5). An overflow from the lower reservoir flows into a collector (7) on a weight scale (8). The amount of liquid evaporated on the

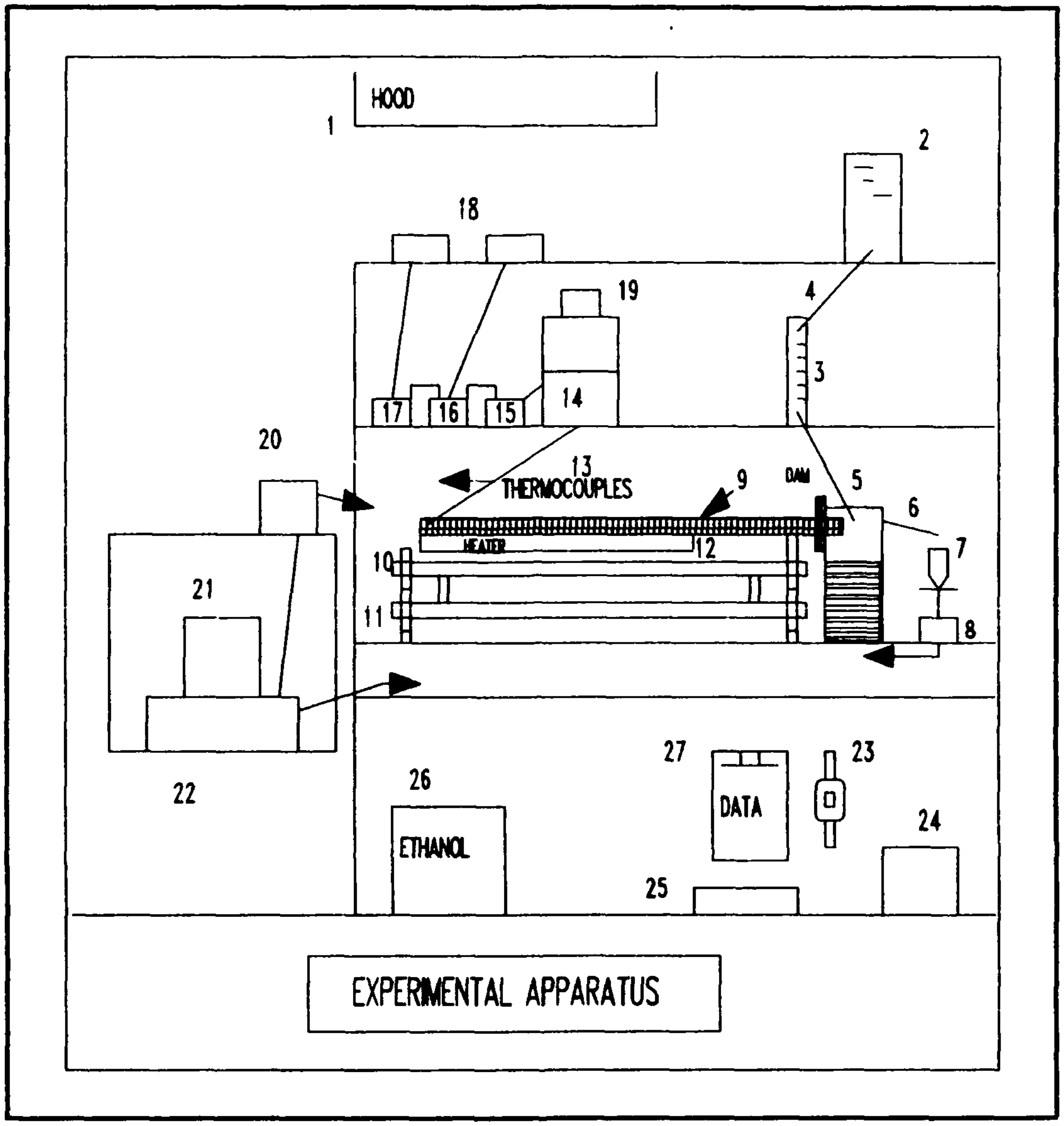

FIGURE 11. EXPERIMENTAL SET UP

TABLE 2

EQUIPMENT LIST FOR FIGURE 11.

No.	DESCRIPTION
1	Exhaust Hood
2	Upper Reservoir - Rubbermaid container

3	Flowmeter - Monostat Calcuflow rotameter, model 36-541-125
4	Tubing - Imperial Eastman black polyflo, ¼" O.D.
5	Lower Reservoir - plexiglass, ¼" thick, 3½"x 6½"x 8½"
6	Overflow Nozzle - ⅝" Copper pipe, adjustable height
7	Overflow Container - 400 ml pyrex glass
8	Scale - Denver Instrument Co. XL-300 precision balance
9	Plate - (See Figures 12.-14.) 99.9% pure hard rolled copper, (QQC-576B), with five axial grooves, ¼" thk
10	Jig - Steel, adjustable angle
11	Leveling Table - steel, threaded legs with rounded ends
12	Heater - Omegalux Ni-Cr strip heater, 1200 W, 23¾" x ¾" x ¼" used with silicone compound heat sink MIL-C-47113B
13	Thermocouples - Glass insulated copper/constantan, Type T, 0.010" diam., (See Figures 12.-14.) Epoxy: REN Plastics RP1250
14	Power Supplies - M.E. model 83B829 dual dc power supply H.P. model 6205C 0-40V/0.3A: 0-20V/0.6A
15	DC voltage to 4/20 mA converter - made in-house
16	Power Controller - Control Concepts Inc., 10 A SCR, model 1025
17	Shunt - standard 10 A current shunt (0.01 ohm)
18	Multimeters - H.P. 3466A Digital; one for current, one for voltage
19	LVDT - Trans Tek Inc. Series 210-220 (not used)
20	Connector - Keithley Metrabyte EXP-16A expansion multiplexer/amplifier system, 16 channel
21	Computer - Zenith 248 Data System
22	DAS Board - Keithley Metrabyte DAS-8 data acquisition and control board (integrated with the computer)

23	Stopwatch - Casio wristwatch
24	Thermocouple Calibrator - Omega Omni-Cal Thermocouple Calibrator
25	Levels - Starret Class 1 9" Level and Plumb
26	Liquid Storage - Ethanol (C_2H_5OH), 99.9% pure (200 proof)

plate is the difference between inflow and overflow. The weight scale is connected directly to the data acquisition system (DAS) board. Inert flexible tubing and steel or brass fixtures are used to prevent chemical interaction with the ethanol. The level of the liquid in the upper reservoir is kept to within 2 cm of the top of the tank to minimize variations in the hydrostatic head which causes the ethanol to flow. The level of the liquid in the lower reservoir could be adjusted by moving the overflow nozzle (6) up or down. The level is adjusted so that the liquid in the lower reservoir is less than 2 mm above the top surface of the plate. Liquid flowed from the lower reservoir up the groove due to capillary action.

The copper plate is shown in more detail in Figures 12., 13., and 14. The thermocouple locations for each of the three grooves studied are also depicted. The plate is made of hard rolled pure copper and has five grooves of different geometries cut into it. A significant dimension, 0.035", is common to the various grooves, e.g. the width of the square or the width of the trapezoid at the top. A portion of one end of the plate is separated from the rest of the plate by a hard rubber collar.

The collar fits snugly around the plate and silicon rubber was used to seal the contact seam while allowing liquid to flow through only one groove at a time. The outside of the collar fits into a notch in the front of the lower reservoir and the perimeter is also sealed with silicon rubber.

The plate sits on a large steel jig. The plate/jig combination is kept level by resting the jig on a leveling table. The upper strut of the jig could be adjusted to a small angle of inclination about the horizontal. The plate does not rest on the jig itself but on some asbestos plugs which insulated it from the jig.

An Incoloy sheathed Ni-Cr heater is suspended in the hollow area between the I-beam webs of the jig by three insulated sheet metal holders. A snug fit maintains close contact between the heater and the plate. Additionally, a silicone compound heat sink is used to improve the thermal contact between the heater and the bottom of the plate. The energy to the heater is delivered via an adjustable SCR power controller.

There are 13 thermocouples mounted on the plate as shown in Figures 12.-14. Additionally, one thermocouple rests in the lower reservoir, and another is attached to the bench nearby to give ambient conditions. The thermocouples are mounted in

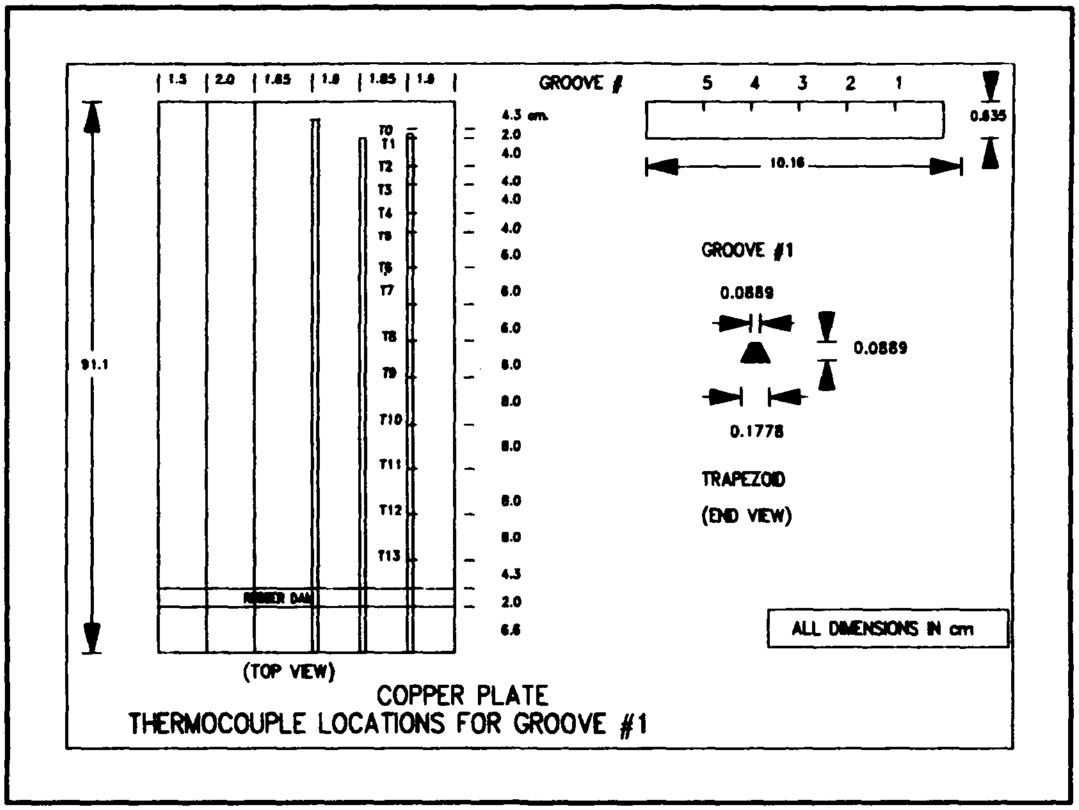

FIGURE 12. GROOVE #1 THERMOCOUPLE LOCATIONS

small holes near each groove. The holes are 2 cm apart along the length of the plate, and approximately 2 mm from the edge of the groove. RP 1250 epoxy is used to hold the end of the thermocouple in the bottom of the hole. The thermocouples are fed to a 16 channel multiplexer which is connected to the DAS board in the PC.

The data acquisition and storage were done with a PC. Immediate temperature distributions and mass flow rates can be read out on the screen for the purposes of data checking or calibration. Data acquisition for an actual experimental run

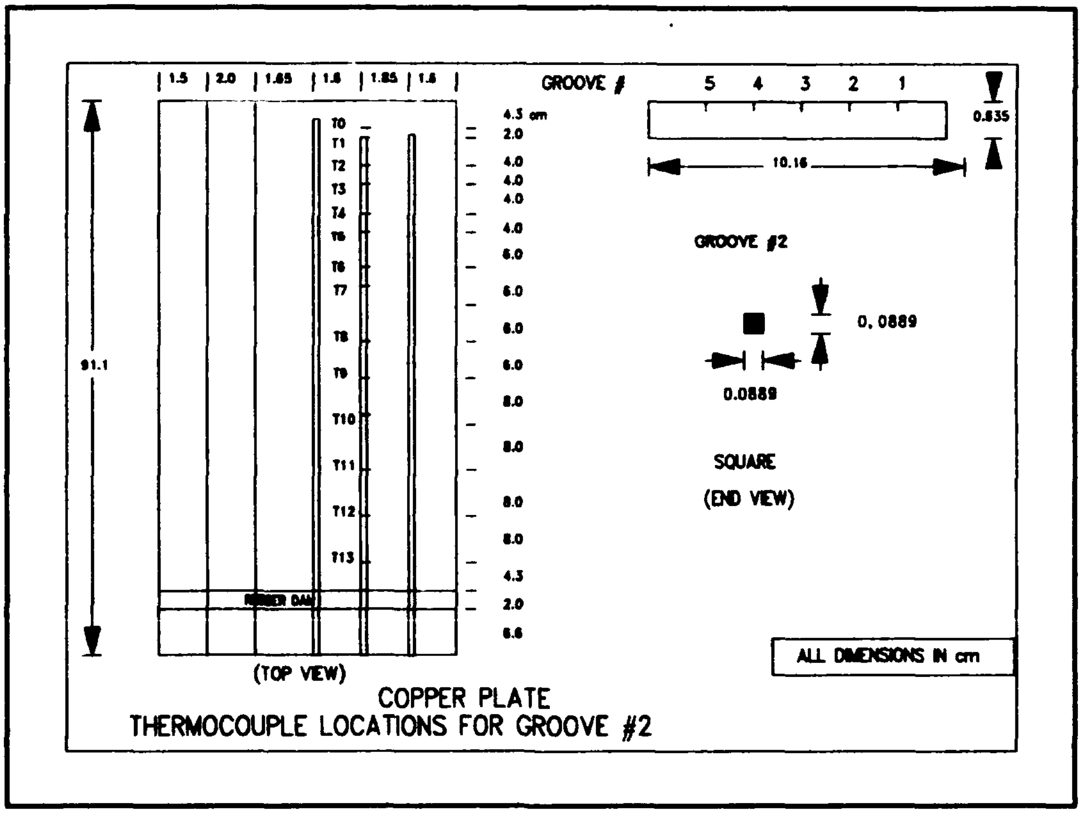

FIGURE 13. GROOVE #2 THERMOCOUPLE LOCATIONS

is initiated and accomplished with the same software.

It was sometimes necessary to plug up the grooves. This was done with wooden toothpicks. Toothpicks and cotton swabs were occasionally used to clean out the groove.

Calibration

Three pieces of equipment were actively calibrated. Each of these and the calibration procedure are discussed below.

The flowmeter was a graduated glass tube with a floating

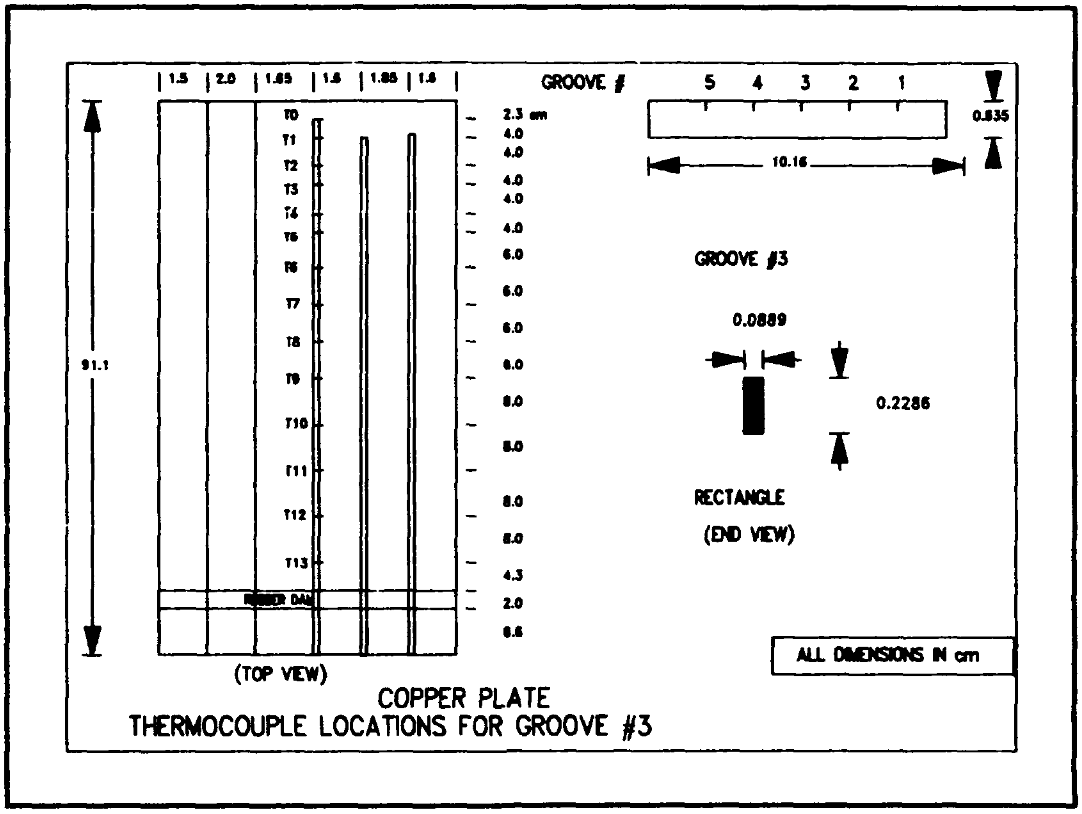

FIGURE 14. GROOVE #3 THERMOCOUPLE LOCATIONS

glass bob. The calibration procedure consisted of plugging up the groove in the plate and opening the valve into the flowmeter until the bob aligned with a particular gradation mark. After steady state was achieved, the DAS was run to measure the flow rate, and an average value for the flow rate at each mark was determined. The procedure was done before any test runs were attempted, and then repeated sporadically for confidence.

The weight scale has a self-calibration feature. Controlled weights totaling 100 grams were placed on the scale and the internal adjustments occurred automatically. The procedure was repeated every day at first, and then weekly afterwards since the scale was consistently maintaining calibration.

The thermocouple readings were calibrated using a thermocouple calibrator. During assembly and after mounting on the copper plate, the thermocouples were attached to the calibrator and readings were compared to those from a control thermocouple. The discrepancies were noted. This procedure was repeated at higher temperatures (after supplying heat to the plate.) The calibrator was also used to send controlled thermocouple signals to the DAS. The bias in the readings from the DAS were noted. Then the software was adjusted by adding or subtracting a small bias for each thermocouple so that the DAS displayed more accurate values for the temperature measurement.

Procedure

The major features of the experimental procedure are listed below:

- The groove was cleaned. The cleaning began with a trichlorotrifluoroethane bath for degreasing. This was followed by a short application of 0.5% muriatic acid. A rinse was done with either methanol or ethanol. A final rinse with distilled water was occasionally done to dispose of solid particles.

- All electrical equipment was turned on to warm up.
- All electrical and tube connections were checked, reservoirs filled, the plate configuration checked, scale and table levelled, thermocouples connections checked, etc.
- The DAS was initiated identifying run designation and zeroing timer; an independent clock was coordinated; thermocouple readings were monitored for problems; the data sheet was initiated.
- The flow meter was set and allowed to equilibrate.
- The groove was normally plugged with toothpicks and paper to prevent run over until the plate was hot enough to evaporate significant amounts of liquid.
- The power to the heater was initiated and recorded. Equilibrium was achieved. During the wait for steady state, power levels were checked and the location of any dryout front recorded. Description of significant events were also recorded on the data sheet.
- At equilibrium, significant measurements were noted. If a dryout front existed, the power was then turned off or reduced to the capillary limit. The location of the dryout front was noted along with the time of arrival at certain gradations along the plate. The time was read from a stopwatch.

Occasional swabbing with a Q-tip was done to clean away small amounts of residue from the groove.

- After the groove rewet, the procedure was repeated for other power settings or the apparatus was shut down. The run times, flow rates, and temperature distribution of the run were recorded on the hard disk and backed up on floppies.

A cold run was also done for each groove. The procedure was similar except that the groove is plugged until the level of fluid in the lower reservoir was constant. The groove was then unplugged and the front movement in the groove noted as above.

Results Summary

This section contains two items; 1) Table 3, a summary of the measurements made for each run; and 2) Table 4, a listing of the experimental runs performed and included in this thesis. (Some runs had problems such as a leaky reservoir and are not included.)

TABLE 3

MEASUREMENTS OBTAINED

Flowmeter setting for mass flow rate into the reservoir.
Overflow mass flow rate to the scale along with the instantaneous scale reading.
15 temperature readings: 13 along plate, one in the reservoir, and one for the ambient conditions.
Run time both from the DAS and from a hand held stopwatch.
The current through and voltage across the heater strip.
The location of any dryout front.

TABLE 4

LIST OF EXPERIMENTAL RUNS

RUN	DESCRIPTION
T1	Temperature distribution at three power levels with no liquid in Groove #2
T4	Similar to T1 but with ethanol
T9	Hot plate run for Groove #1 similar to T1
T10	Flow rate check with ethanol
G2E2	$Q_{c,max}$ for Groove #2
G2E3	" "
G2E4	" "
G2E5	Dryout front movement for $Q_{out}/Q_{c,max} = 0$ and 1
G2E6	Cold run for Groove #2
G3E1	$Q_{c,max}$ for Groove #3
G3E2	Dryout front movement for $Q_{out}/Q_{c,max} = 0$ and 1

G3E4	Cold run for Groove #3
G1E1	$Q_{c,max}$ for Groove #1
G1E2	Cold run for Groove #1
G1E3	$Q_{c,max}$ for Groove #1
G1E4	Dryout front movement for $Q_{out}/Q_{c,max}$ = 0 and 1

Software

The software is comprised of two items. The DAS-8 data acquisition system includes a library of commands which are called up by the controlling program to accomplish things like zeroing the reference thermocouple channel, multiplexing the thermocouple readings, and accepting a string of data from the weight scale. The controlling program is a four-function program written in GW-Basic. The four functions include: 1) Run initiation which includes run designation, flow rate setting, groove #, plate angle, and others, 2) Mass flow rate measurement which is a real-time flow rate without the clock running or data storage, 3) Plate temperature readings which again are real time without the clock running or data storage, and 4) data acquisition initiation which begins the run clock and makes periodic measurements during an experimental run for storage in a data file.

V. RESULTS AND DISCUSSION

The experimental results are documented and the significant, pertinent trends are discussed in this chapter. Various items which demonstrate the consistency of the results are included to give confidence in them. The precision and/or uncertainty sources of the experimental technique are addressed, as well as an explanation of the data which are contained in the appendices. Finally, improvements to the experimental technique are indicated.

Results

Plate Characterization.

Temperature Distribution.

A typical temperature distribution for the plate is shown in Figure 15. The temperature in the evaporator section is fairly constant and then drops down in the reservoir to approximately the temperature of the surroundings. In subsequent steady-state calculations, it is assumed that the evaporator section is constant at $T_{e,ave}$, and then drops down to T_{sur} in the reservoir.

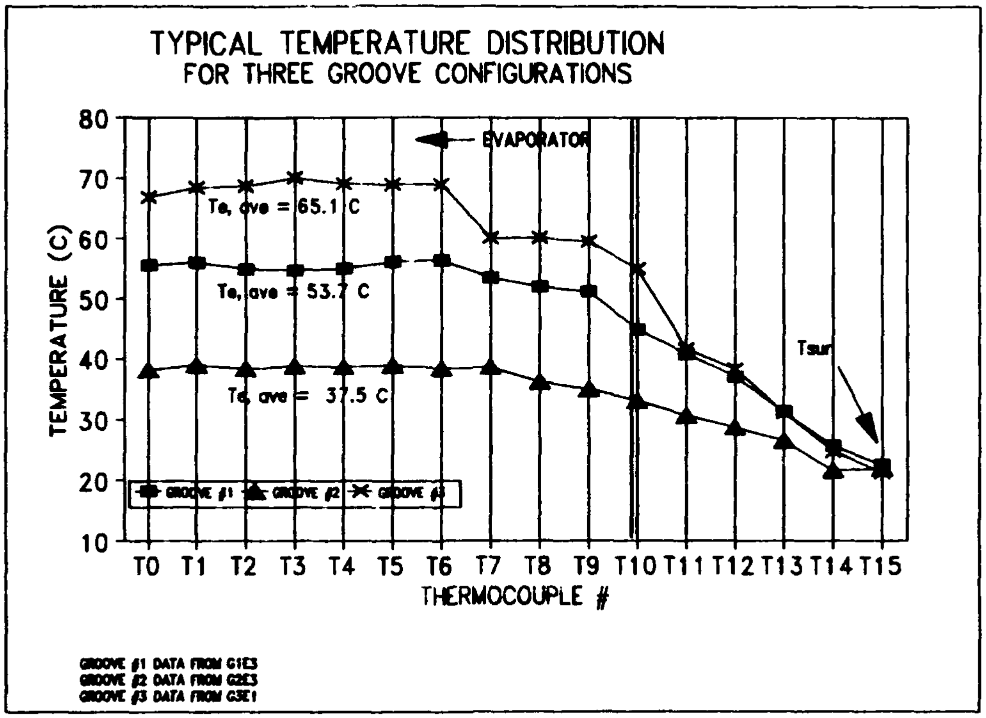

FIGURE 15. PLATE TEMPERATURE DISTRIBUTION

Thermal Time Constant.

A special test, Run Designation T1, was performed to determine the thermal time constant, τ, for the plate (among other things.) The plate was heated to 76°C and then the power was shut down. The subsequent temperature profile change is modeled by

$$\frac{T-T_\infty}{T_i-T_\infty}=e^{-t/\tau} \tag{27}$$

In Table 5, the results for the thermocouple locations in the evaporator section are shown. For the evaporator section, the average value for τ is 24.8 minutes with a standard deviation of 2.72 minutes. If segment T10 is eliminated, the average value for τ is 24.0 with a standard deviation of 1.18. Segment T10 is at the upstream end of the evaporator section where conduction is the predominant heat transfer mechanism. This violates the assumptions in the thermal time constant analysis (Incropera and DeWitt, 1981:174.)

In the temperature range at which experiment T1 was conducted, the average value of the heat transfer coefficient was found to be h_c = 22.8 W/m^2C (See Equation (15).) Using this value with the top surface area of the plate in the evaporator section plus the bottom surface area of the segment of the plate in the lower reservoir, the value of τ which can be shown to be equal to $\rho * V * Cp / h_c * A_s$ (Incropera and DeWitt, 1981:179) equals 23.1 minutes. This number is in good agreement with the data.

Another assumption violated in the lumped capacitance method is that the entire plate is at the same temperature. A correction can be made to the theoretical result by using the temperature data to determine an effective energy storage volume. This is not as relevant here since at these higher temperatures almost the whole volume of the plate (0.9 Vol) has significant energy storage changes. It is relevant below in further discussions about the time constant.

TABLE 5

THERMAL TIME CONSTANT MEASURED IN THE EVAPORATOR

Location	T0	T1	T2	T3	T4	T5
τ_{ave} (min)	24.6	25.0	23.5	24.0	23.7	23.4
Location	T6	T7	T8	T9	T10	
τ_{ave} (min)	23.6	23.7	23.5	25.2	32.5	

Maximum Capillary Limit.

In Figures 16. - 21., the measured values for $Q_{c,max}$ are compared to the theoretical values for the three grooves. A horizontal line with uncertainty bands locates the value of $Q_{c,max}$ measured experimentally. The vertical line labelled $L_{t,max}$ is the value of L_t using the length of the groove over the heater as L_e (evaporator length), and the distance from the front of the dam to where the heater ends as L_a (adiabatic length.) It is labelled a maximum because it gives the

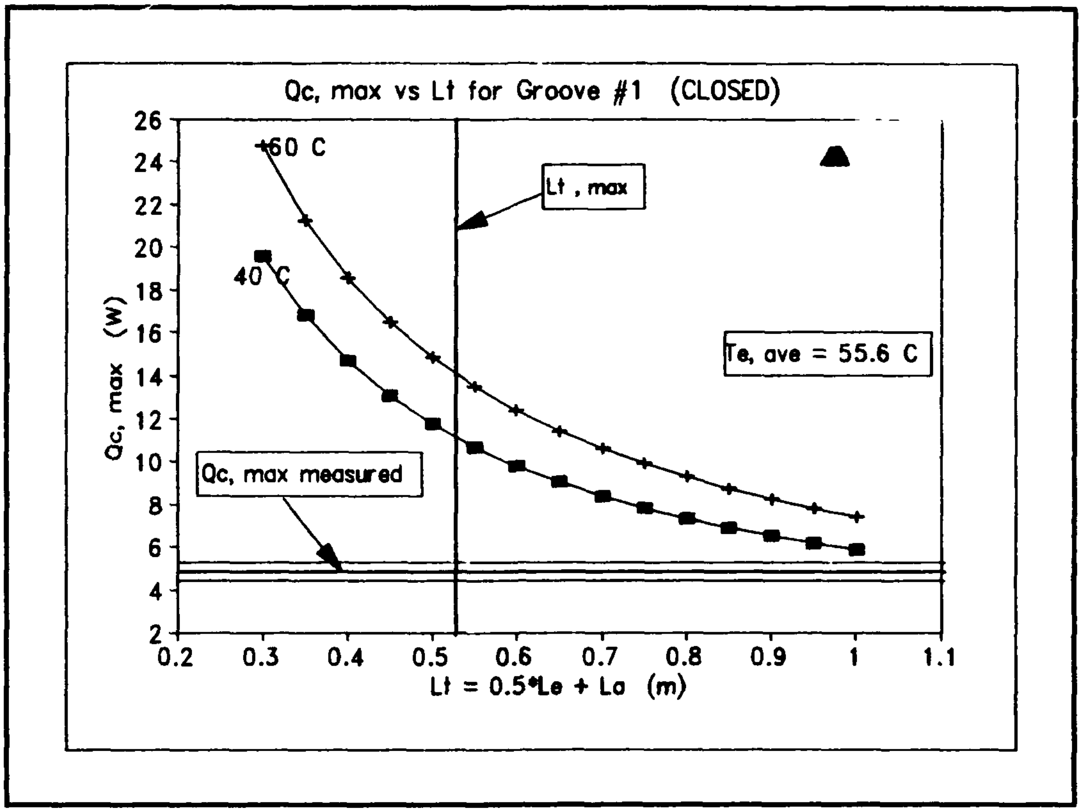

FIGURE 16. $Q_{c,max}$ FOR GROOVE #1 - CLOSED ENDED

maximum value for $Q_{c,max}$. It is an approximation because the liquid actually travels farther in the groove than from the front of the dam to the groove end. The curved lines reflect the equations for $Q_{c,max}$ developed in Chapter III (See Equation (16).) These lines are labelled by the temperature at which the fluid properties are evaluated. Also shown are the average temperatures in the evaporator sections of each plate, $T_{e,ave}$. Figures 16. - 18. are for the case in which the significant dimension for capillary pumping is the width of the groove which corresponds to the closed-ended theory (See

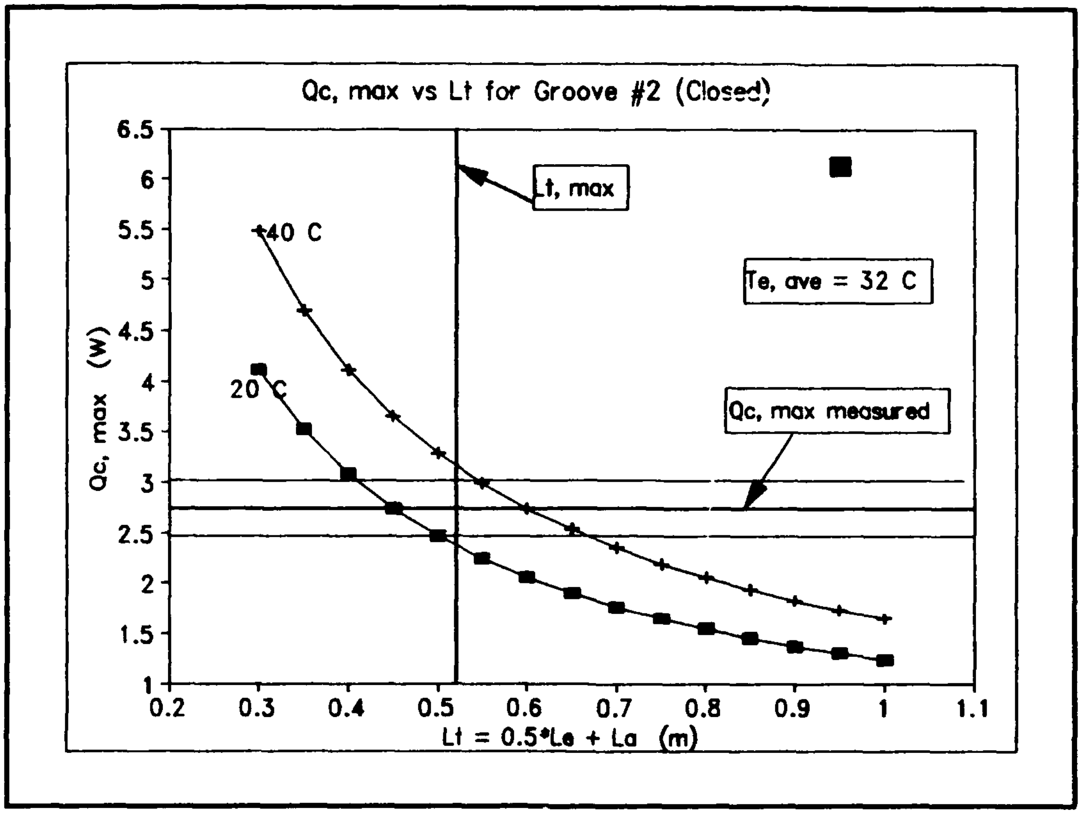

FIGURE 17. $Q_{c,max}$ FOR GROOVE #2 - CLOSED ENDED

Chapter III.) Figures 19. - 21. utilize the hydraulic radius, R_h, as the significant dimension for capillary pumping which is the appropriate dimension for use with an open-ended theory.

Examination of Figures 16. and 19. shows that for Groove #1 neither the closed nor the open-ended theoretical lines match the experimental data well. To get the theoretical line for the trapezoidal shape of Groove #1, approximations are used to determine the friction factor and the maximum capillary pressure drop which is based on the dimension of the open top

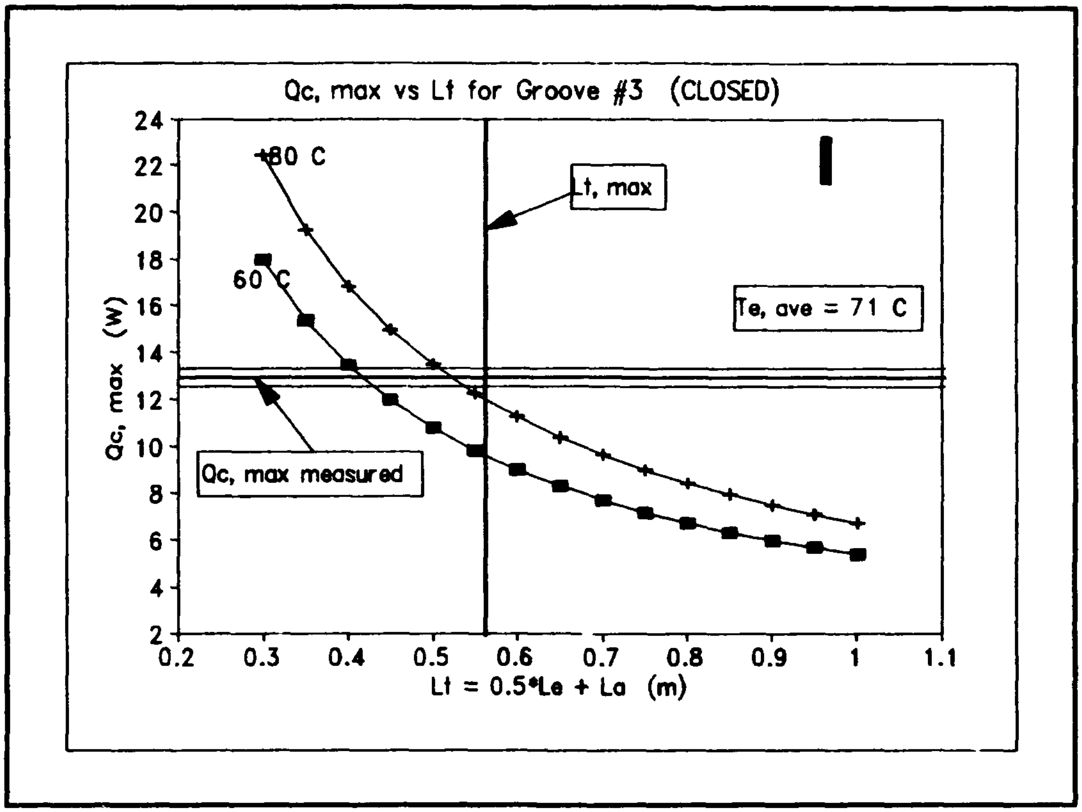

FIGURE 18. $Q_{c,max}$ FOR GROOVE #3 - CLOSED ENDED

of the groove. It is interesting to note that while this geometry has a potential to have very small dimensions (in both corners) for developing a high capillary pressure drop, the data shows a lower value of $Q_{c,max}$ than predicted. It may be that larger values for the friction factor and the significant dimension of the groove than the ones used in Equation (14) are appropriate. For example, using the value of the groove width at midheight and increasing the friction factor constant to 30 from 16 gives a value of $Q_{c,max}$ in the closed-ended case which is exactly that measured.

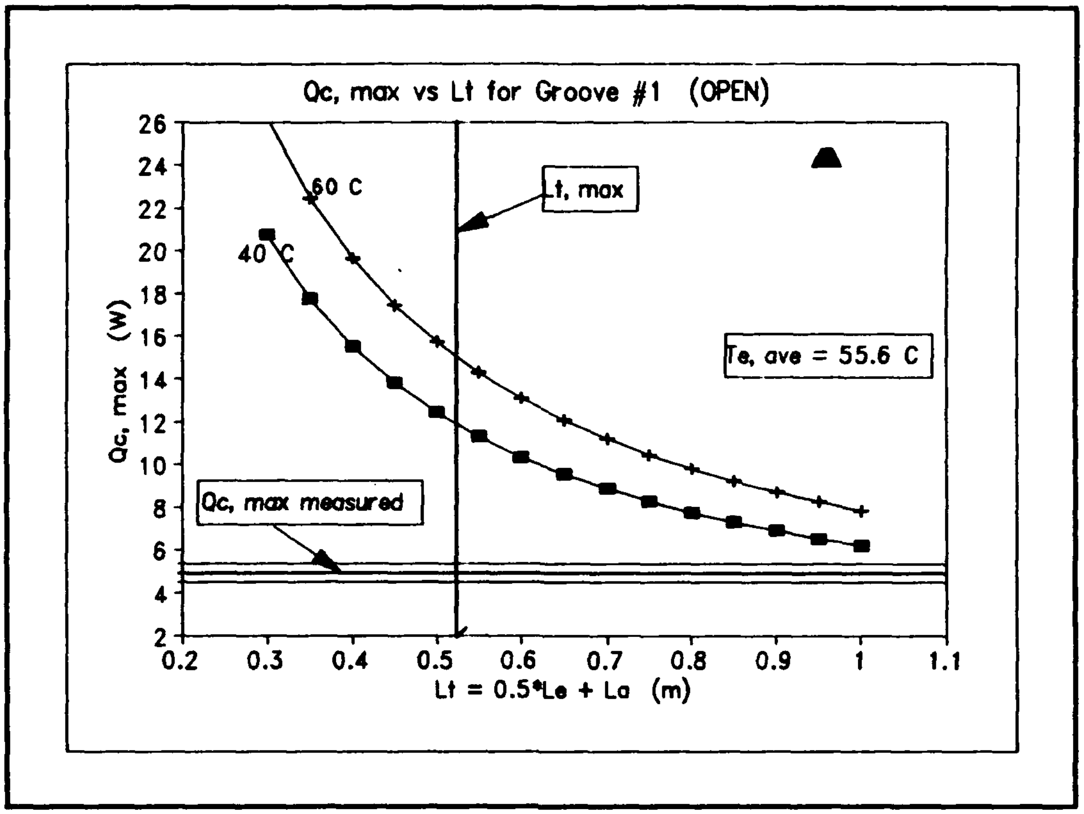

FIGURE 19. $Q_{c,max}$ FOR GROOVE #1 - OPEN ENDED

Figure 17. shows that the theory for a closed-ended Groove #2 is in very good agreement with the experimental data. The open-ended groove theory predicts a value of $Q_{c,max}$ which is approximately 50% higher than determined experimentally. Of the three grooves, this one has the simplest geometry to model since it is shallow and symmetric in two dimensions like a circular pipe for which the theory was developed. Since the theory best fits the square geometry, it is no surprise the agreement is so good.

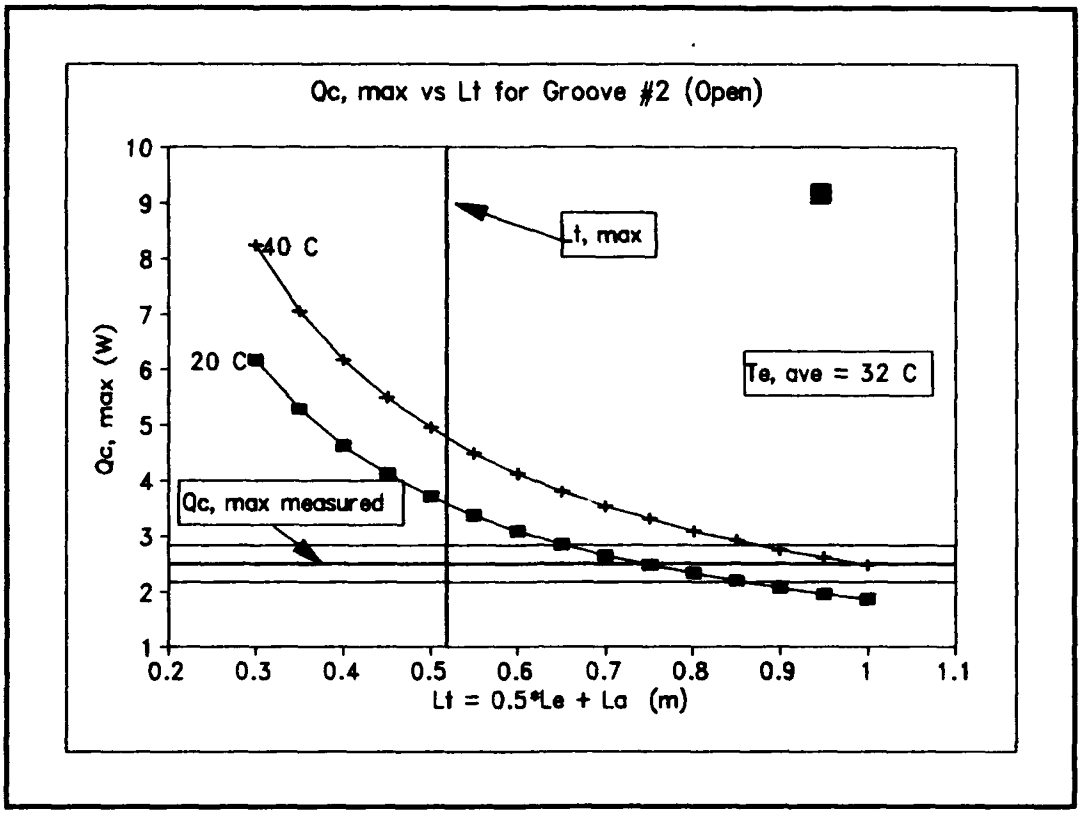

FIGURE 20. $Q_{c,max}$ FOR GROOVE #2 - OPEN ENDED

Figures 18. and 21. for Groove #3 show both the closed and open-ended theories give fairly good agreement. For the closed-ended case, the experimental result is higher than theory. The aspect ratio is 1/3 for this groove. The surface area in contact with the liquid increases seven times more quickly per unit length than for Groove #2. This may mean deep grooves are more sensitive to L_t than shallow grooves like Groove #2 which has an aspect ratio of 1. Also, the depth of Groove #3 adds a hydrostatic head, ignored in the theory, which is three times larger than the other grooves.

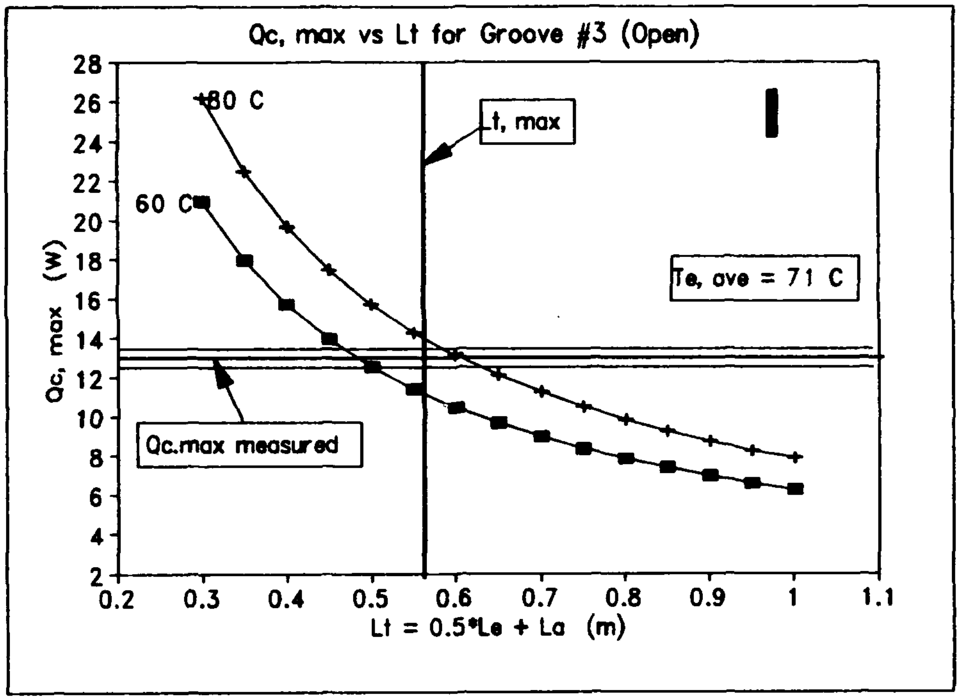

FIGURE 21. $Q_{c,max}$ FOR GROOVE #3 - OPEN ENDED

Qualitative Descriptions.

Before showing the experimental measurements of steady-state and transient behavior of the apparatus, a qualitative description of the liquid front geometry, liquid flow and other pertinent items will be given.

General.

Ethanol was a very good choice of fluid for this experiment. The original choice was water (see below for a discussion of the change) since a clear fluid allows better observation. It was interesting to follow the movement of small particles in the liquid as they wended their way down the groove. The flow appears to be laminar as predicted since the particle motion was in a straight line. The ethanol fumes in such a small channel were easily dispersed by the overhead hood. The ethanol easily wet the copper plate and the value of the contact angle is assumed to be close enough to 0° that cos θ is approximately equal to one. A small puddle usually formed on the downstream side of the rubber dam which insured the radius of curvature of the liquid in the groove was infinite, both axially and transversely there. It also indicated a small hydrostatic head existed due to the fluid level in the reservoir being slightly higher than the top of the plate. This head is not accounted for in this analysis. The depth of Grooves #1 and #2 are so small that hydrostatic head is also ignored. It may be a more significant factor for Groove #3 which is 2.3 mm deep and which had a value for $Q_{c,max}$ better than predicted by theory.

Front Geometry.

A detailed description of the dimensions and shape of the liquid front is not possible with this experimental set-up, but certain comments can be made. First, determining where the liquid front is located was initially difficult because there appears to be a vapor film present in the groove which makes the walls appear damp. However, a flashlight is used to shine light up the groove toward the reservoir, and the front location is made obvious by a strip of reflected light which runs across the bottom of the groove. This means that a smooth transition is not present, but an abrupt, nearly vertical liquid surface at the bottom of the groove exists as shown in Figure 22.

Another aspect of the front geometry is the behavior of the liquid in small dimension features of the groove. In all three grooves, liquid runs ahead of the bulk of the ethanol in the corners of the groove. A U-shaped front looking down from the top is the result (See Figure 22.) A question arises about the appropriate dimension to use for capillary pumping determination. In the corners, as the volume of the fluid decreases, the radius of curvature of the liquid also decreases. The capillary pressure difference should be larger there. This is particularly pertinent in the case of Groove #1, the trapezoid. However, there is a limit to the

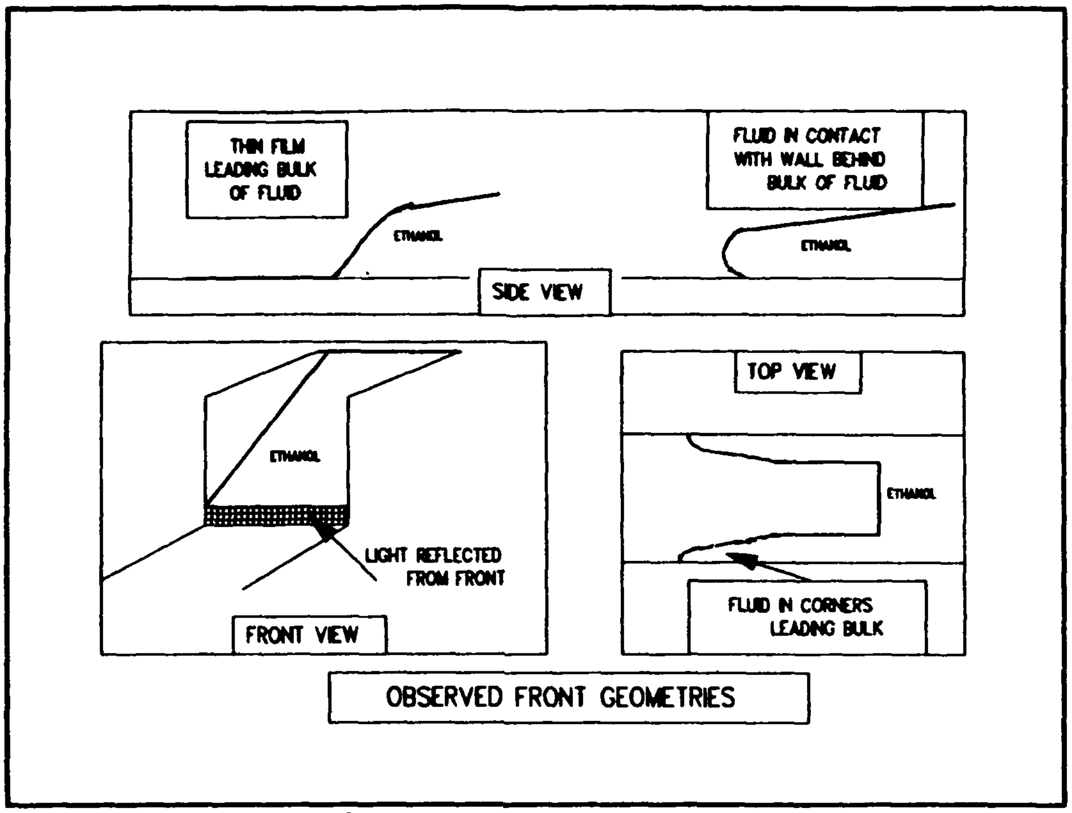

FIGURE 22. OBSERVED FRONT GEOMETRY

size the meniscus can achieve. Since $P_{vap} = P_{liq} + (2\sigma/R_c)$, and since P_{liq} cannot be negative, R_c is constrained to be larger than $2\sigma/P_{liq}$. This is independent of the groove dimensions.

The above discussion points out that the liquid front geometry is not the smooth, circular shape depicted in the theory. It is normally U-shaped and vertically attached to the wall. It is hard to justify considering either the groove width or the hydraulic radius anything more than an approximation.

In Chapter III the claim that the liquid remains attached to the top opening of the groove is discussed. In the case of the trapezoid, the top opening is smaller than the bottom dimension. This is supposed to result in higher performance for this groove geometry. In no case was this behavior observed for Groove #1. The liquid surface recedes down the sides of the groove and dries out at the bottom just like the other two grooves. The performance of this groove is nearly twice as good (in terms of $Q_{c,max}$) as that for Groove #2, but the cross sectional area for flow is also twice as large while the surface area for shear stress is only 40% larger. An interesting aspect of the rewet behavior of Groove #1 is the multiple "fronts" visible as the liquid moves back toward the groove end after dryout power is shut down. An explanation for this may be that as the trapezoidal groove fills back up, the fluid creeping up the sloping sides advances in stages. A cascade of liquid results, and the multiple light reflections are a manifestation of this.

Microgrooves were also present in all three grooves but they were most obvious in Groove #3. They are due to imperfections in the manufacturing techniques, either the saw blade or milling tool scratched secondary channels as the primary groove was cut. Liquid is normally evident in advance of the bulk of the fluid in these microgrooves, but their effect on the plate performance is not addressed. The very small amounts of liquid in these grooves should evaporate without large heat inputs, so the capillary limit should not be affected. However, these microgrooves may facilitate the chemical surface conditioning which is discussed in a later section.

Front Stability.

It became clear during the experimentation that two types of dryout are possible. The first is a quiescent evaporation. All fluids which are left in a container at room temperature will eventually evaporate. For liquids like oil which have a low vapor pressure, this may take a long time to happen. But for ethanol, water, and other common fluids, this can happen relatively quickly. As the temperature of the fluid is raised toward the saturation point, the evaporation rate increases. One could define a capillary limit for a table top if a liquid is dripped slowly enough onto the table top that the time between successive drops is just long enough to allow evaporation of the previous drop to occur. In the groove, this quiescent evaporation causes dryout of the groove before boiling begins. The temperatures at dryout are 55.6°C, 34.2°C, and 71.0°C for Grooves #1, #2, and 3 respectively. All of these are below the boiling point for ethanol which is 78°C at one atmosphere.

As the dryout front moves away from the end of the groove by increasing the heat input to the plate, the temperature increases and, at least for Groove #3, boiling is established at the dryout location. A section of the groove approximately 5 cm long experiences nucleate boiling. This boiling causes waves to travel back up the surface of the liquid a short distance. This agitation of the liquid by bubbling action helps initiate front motion after power is turned down in a dryout situation. A small amount of bubbling is also evident for Groove #1 but it is back in the corners of the groove and does not manifest itself as readily as in the case for Groove #3.

Two things should be said about these different mechanisms for evaporation. First, a boiling front is far from the smooth and circular, or flat and square front used in modeling this phenomena (Peng and Peterson, 1992:564). The amplitude and frequency of the bubbling could be determined, and an average radius of curvature may be defined for capillary pumping determination purposes. The liquid front is no longer constrained to be attached to the walls as bubbles provide an attachment point also. Second, the stability of the front location in the two cases is starkly different. For quiescent evaporation, the front could easily be stabilized at any of a number of locations within approximately 3 cm ahead or behind a certain point. In the boiling case, efforts to move the boiling location were fruitless. Since quiescent evaporation utilizes the full surface area of the liquid in the evaporator and some of the liquid surface area in the adiabatic section to accomplish dryout (approximately 70 cm in this apparatus), and since in the boiling situation, the evaporation is accomplished in a very small length of liquid (approximately 5 cm), it may be that the former case is not as sensitive to small changes in the front location, hence a range of stable front locations exists.

Surface Residue.

An effort was made to keep the grooves clear of debris during the testing to avoid disturbances to the flow. A cotton swab was occasionally used to clean the grooves in advance of the moving liquid. A yellowish residue was often found on the swabs after cleaning. This residue was not there after the preliminary cleaning of the groove done before each experimental run. Hence it must be left by the ethanol, or a combination of ethanol and copper oxides. It is particularly hard to clean the corners in the case of Groove #1 since the sloped nature of the groove walls denied ready access. This may contribute to difficulties in rewetting. It appeared that as the liquid front moves along the groove, a small stream of brown substance migrates slowly into the middle of the clear ethanol. Apparently, some chemical conditioning of the groove walls is necessary for the fluid to pass by. Removing this residue may be a precursor to the proper wetting angle needed for the liquid to advance further down the groove. Although it is observed that the fluid front reacts almost immediately to a decrease in power, in some cases the initial lurch forward slows subsequently. If this chemical conditioning fouls the liquid at the front, this could have a significant effect on overall performance. Most heat pipes are charged with just enough liquid to fill the grooves, plus or minus 10%, because performance is strongly dependent on the amount of over- or undercharge (Harwell, et al. 1977:18.) Since the overcharge or undercharge is kept to within a small range, if a small amount of the liquid becomes fouled and cannot be purged from the groove, normal operation may be impeded. Particularly in the small dimension areas of the grooves, where the amount of surface area relative to the liquid volume is high, this fouled liquid may build up and impede rewet. If this happens in the relatively large dimensions of an axial groove, the likelihood is favorable it would happen in the case of a sintered or mesh wick which has a comparatively large surface area in contact with a small amount of liquid which might explain difficulties in rewetting these types of wicks.

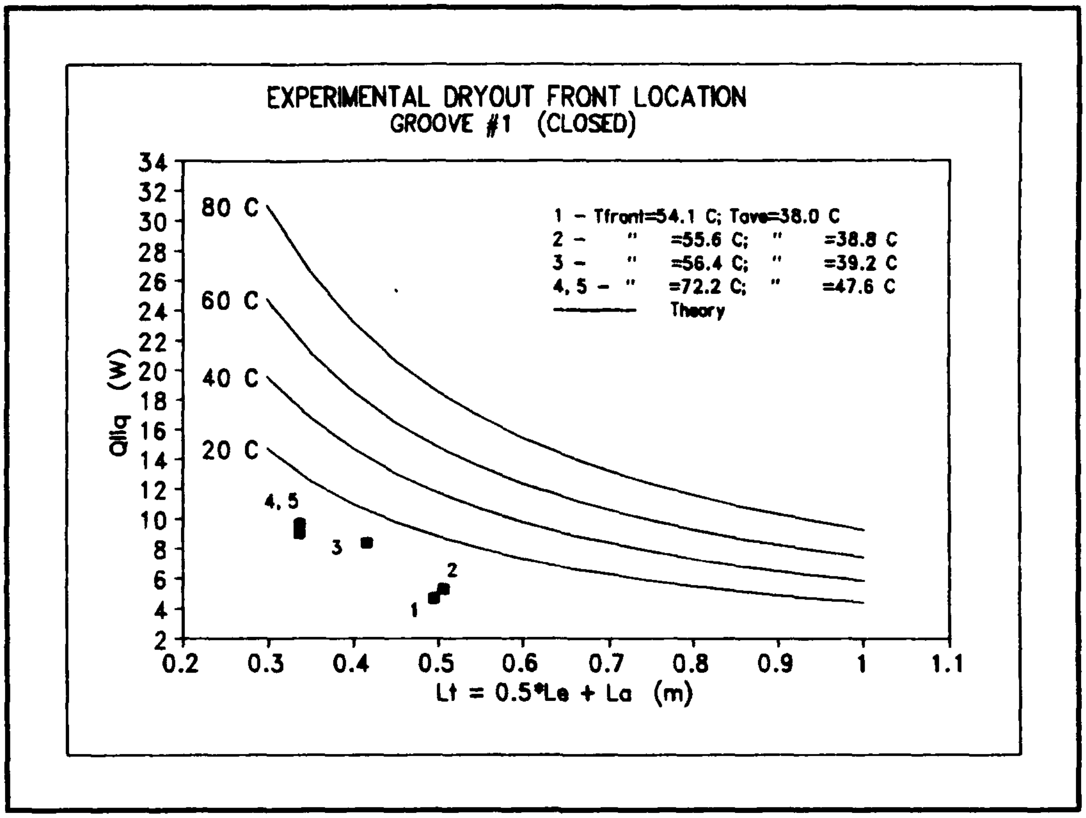

FIGURE 23. DRYOUT FRONT LOCATION FOR GROOVE #1 - CLOSED

Dryout Front Location.

Now that the plate has been characterized by physical dimensions (Chapter IV), steady-state and transient heat transfer behavior, and capillary limits, experimental data which may be used to validate models of the phenomena of heat induced dryout capillary flow in grooves are introduced. The first topic involves a steady state condition. How does one predict the location of the dryout front given the groove and liquid specifications, and the heat input?

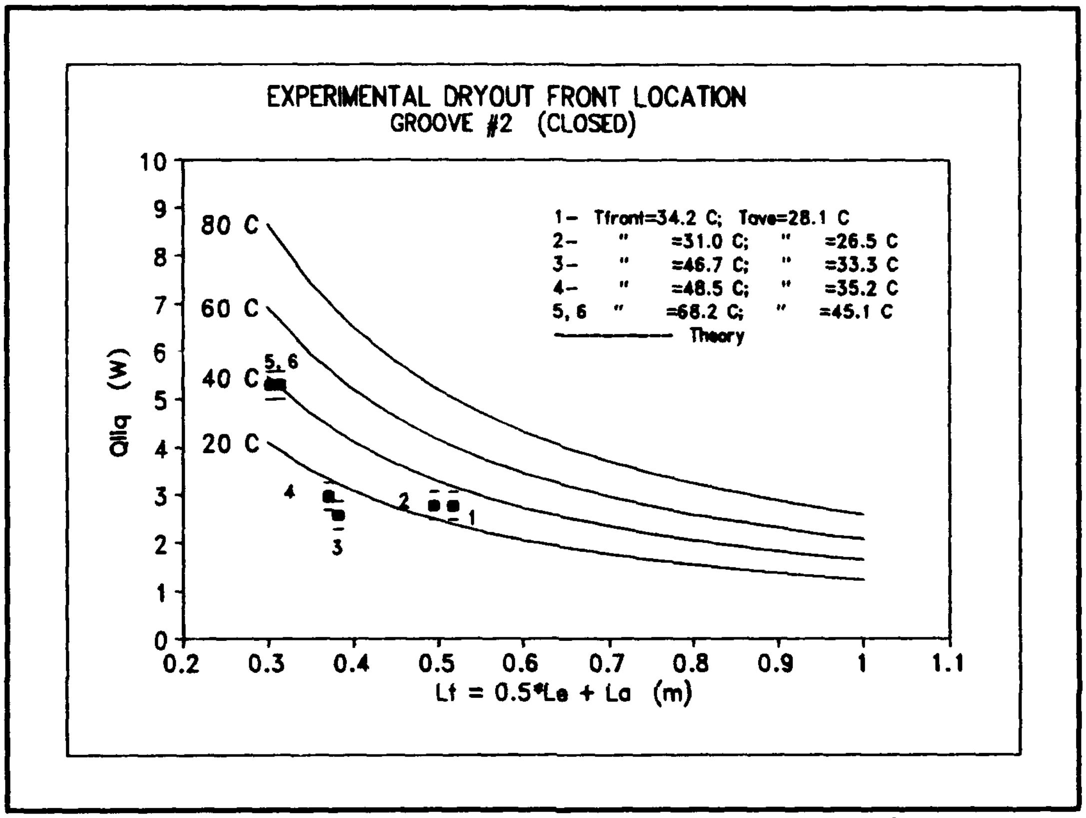

FIGURE 24. DRYOUT FRONT LOCATION FOR GROOVE #2 - CLOSED

In Figures 23. - 28., the experimental results are shown for various conditions in the three grooves. Figures 23. - 25. are the graphs for Q_{liq} vs L_t which utilizes the same theory as for $Q_{c,max}$ except that now, the dryout front location at steady-state, with respect to the end of the groove, is subtracted from L_e. A similar presentation is done in Figures 26. - 28. utilizing the open-ended theory.

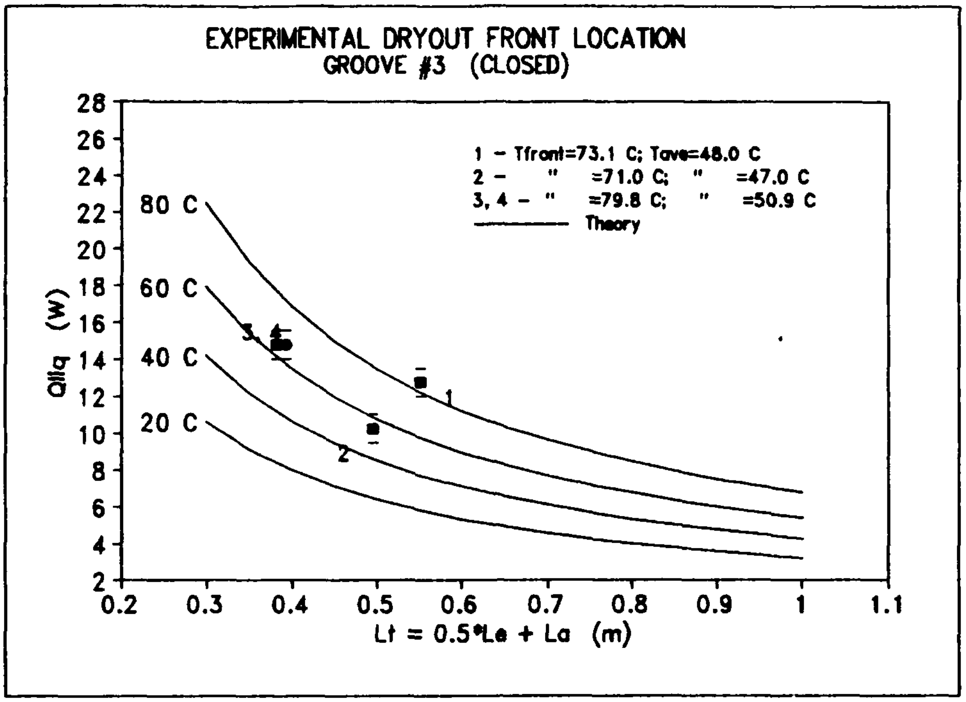

FIGURE 25. DRYOUT FRONT LOCATION FOR GROOVE #3 - CLOSED

For Groove #1, the open-ended and the closed-ended theories are very close since the hydraulic radius of Groove #1 is very nearly equal to the width of the groove. In neither case are the results in good agreement with theory. The experimental data are below where they should be if the theory was applicable. Many of the reasons stated above for the lack of agreement for $Q_{c,max}$ with the results for this groove apply here also. For Groove #2, the agreement does not appear good either, but the closed-ended case is closer than the open-ended case. For Groove #3, the results are fairly good,

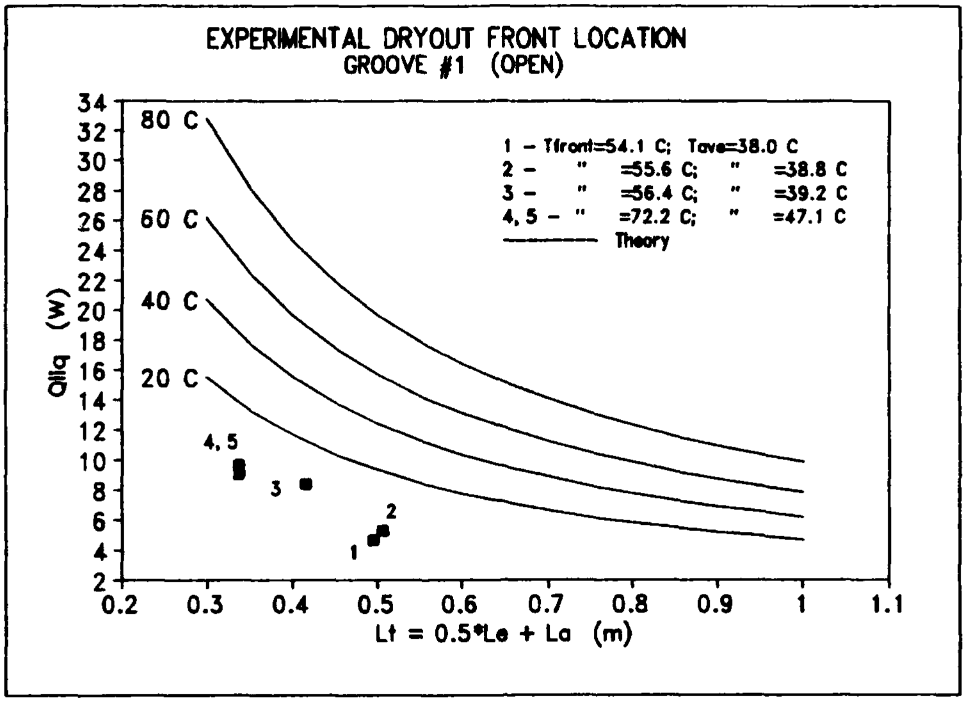

FIGURE 26. DRYOUT FRONT LOCATION FOR GROOVE #1 - OPEN

particularly in the case of the closed-ended theory.

In general, three observations can be made. First, all of the results seem to be lower than predicted by the simple theory for Q_{liq} which balances friction and capillary pumping forces. An assumption made in this theory is that all of the fluid is at the constant saturation temperature of the fluid.

In the experiment, the replacement fluid comes from a reservoir which is basically at room temperature. The higher the heat influx to the liquid, the further back the dryout front, and the shorter the distance the fluid has to travel

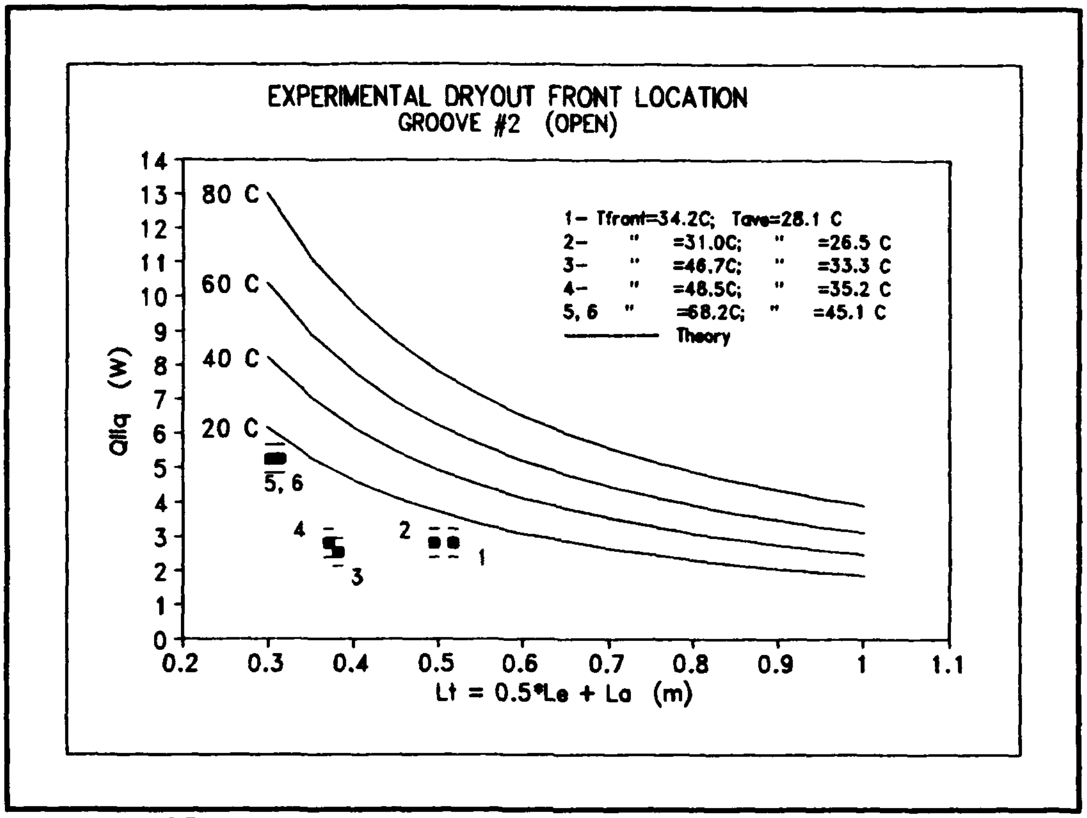

FIGURE 27. DRYOUT FRONT LOCATION FOR GROOVE #2 - OPEN

before evaporation. This may mean the appropriate bulk temperature to use for determining fluid properties is somewhere between T_{front} and T_{sur}. This would accommodate the data falling on a theoretical line which is at a lower temperature as depicted in the figures for low values of L_t (large dryout lengths.) However, it seems that the worst agreement is for intermediate dryout lengths, i.e. when the front is fairly near the end of the groove as in conditions 3 and 4 for Groove #2 and condition 2 for Groove #3. Although the basic trend in the data matches that predicted by theory,

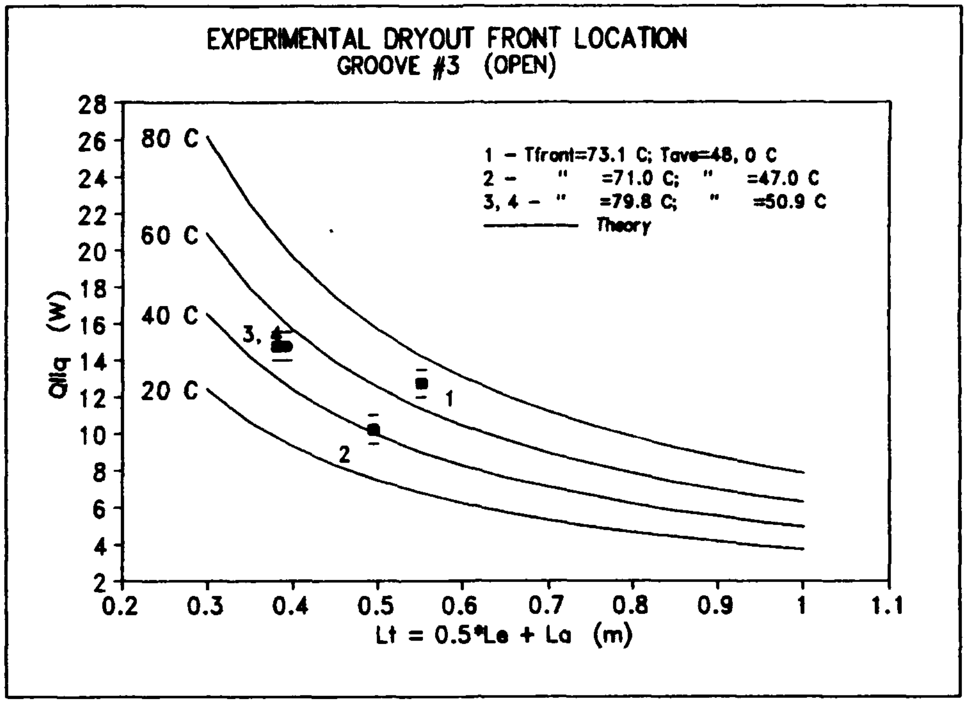

FIGURE 28. DRYOUT FRONT LOCATION FOR GROOVE #3 - OPEN

i.e. nonlinearly higher Q_{liq} as L_t gets smaller, the intermediate conditions consistently dip lower than $Q_{c,max}$. This is not the predicted behavior. Note also the ratio of heat transfer area to flow area for the three grooves are as follows:

Groove #1 - WP/CXA = 2.12/w

Groove #2 - WP/CXA = 3.0/w

Groove #3 - WP/CXA = 2.33/w

where WP is the wetted perimeter in contact with the fluid for heat transfer, CXA is the cross sectional area of the groove, and w is the groove width (at the top for Groove #1.) The results of Groove #2 should be better than those for Groove #3 since the ratio of wetted perimeter for heat transfer to area for mass flow is larger for the square groove. This is an important parameter for determining how quickly the fluid heats up. But Figure 24. shows that for the closed ended case, the agreement is no better than Figure 25.

Second, the simplified Q_{liq} theory assumes that the full cross sectional area is used for fluid flow when determining the velocity of the liquid. This is clearly in violation of what was described as the cause for capillary pumping between the ends of the groove. The groove is full in the condenser and nearly empty in the evaporator. An effective area which is smaller than the full cross sectional area of the groove should be used for this purpose. Especially with small grooves, a meniscus receding into the groove quickly changes the total cross sectional area for mass flow while the perimeter of fluid in contact with the groove walls remains large as shown in Figure 29. Consequently, the actual fluid velocity is higher than assumed since the same mass flow rate which equals ρAV is flowing through a smaller area and ρ is constant. Higher velocities tend towards greater shear stresses. And while the area for flow is smaller as the meniscus recedes into the groove, the area for shear stress remains the same since the liquid remains attached to the

AFIT/GA/ENY/92D-06

A STUDY OF HEAT FLUX INDUCED
DRYOUT IN CAPILLARY GROOVES

THESIS

TIMOTHY J. MURPHY, CAPTAIN, USAF

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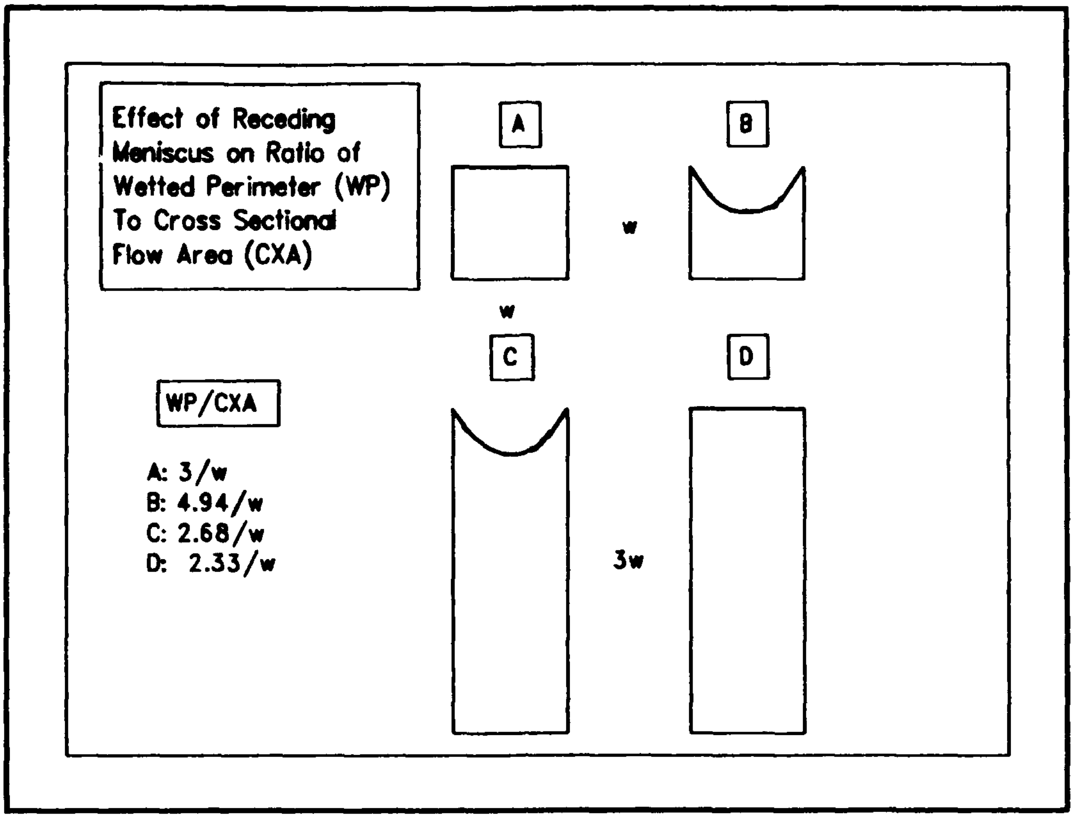

FIGURE 29. EFFECT OF MENISCUS ON AREAS RATIO

entire groove wall. For example, if the cross sectional area for Groove #2 were reduced by 10%, the results would be as shown in Figure 30. for the closed-ended case. Similarly, if the cross sectional area were reduced by 30% for the open ended case, the results would be as shown in Figure 31. Both have better agreement with theory. This would also explain why Groove #3 has better results, since for a deep groove, a meniscus radius is a smaller proportion of the groove depth than in a small square groove, hence the cross sectional area for flow would not be affected as much. (See Figure 29.)

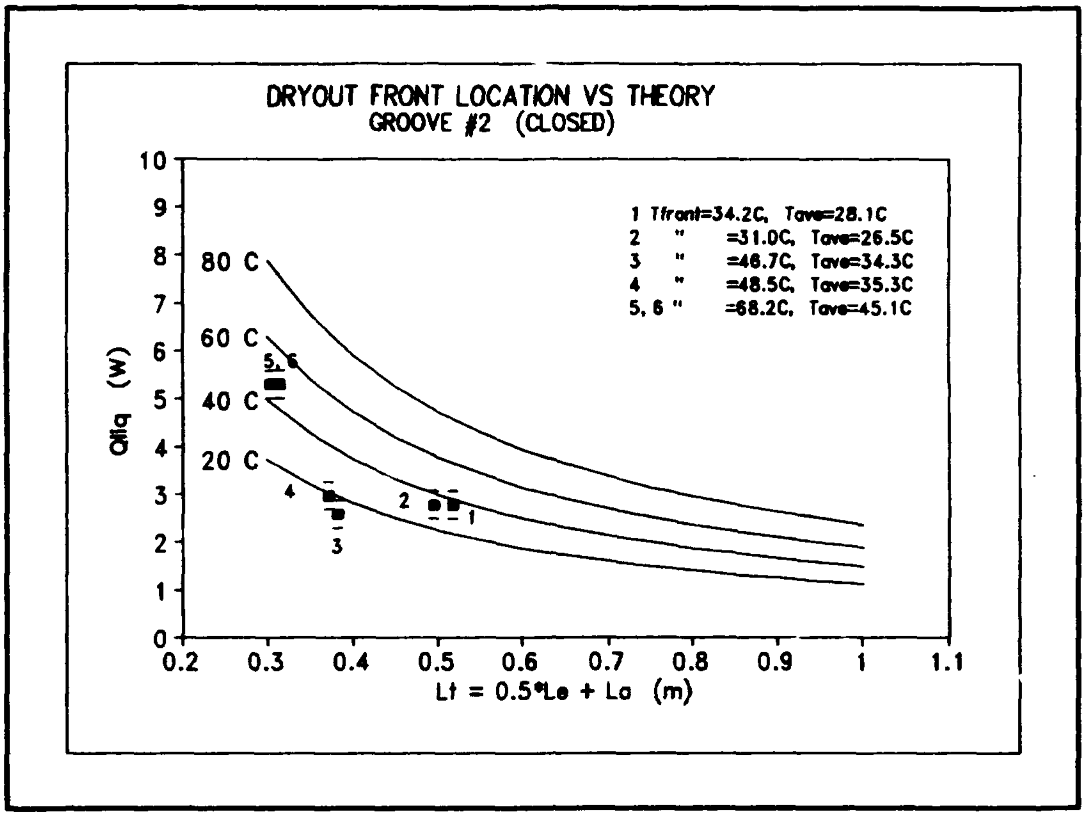

FIGURE 30. EFFECT OF USING REDUCED AREA OF FLOW FOR GROOVE #2 - CLOSED

Third, the geometry at the front has an effect on the total pressure drop achievable between the condenser and wherever dryout occurs. The simplified theory assumes a round meniscus. Particularly in the case of large dryout in Groove #3 where a 5 cm long section of the groove contained boiling ethanol, this assumption is clearly not correct. For Grooves #1 and #2, the location of the dryout front could be determined by shining a flashlight from the grooves end toward the reservoir. A strip of light reflected back from the

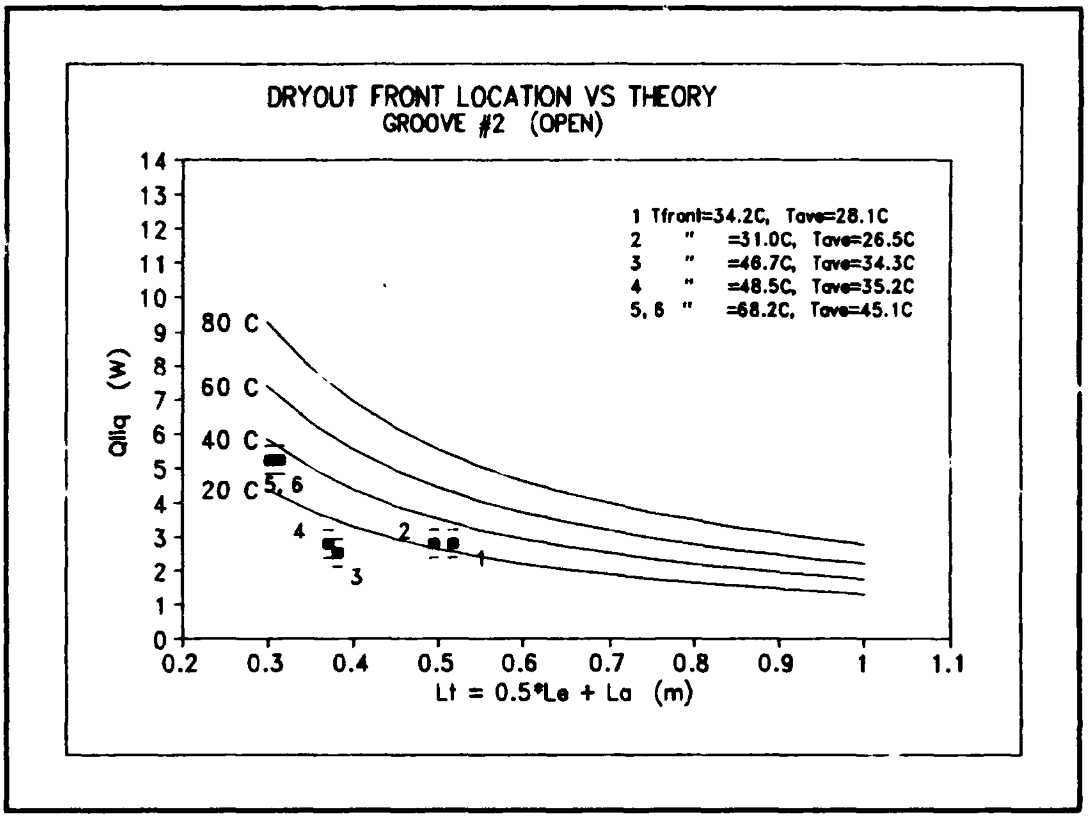

FIGURE 31. EFFECT OF USING REDUCED AREA OF FLOW FOR GROOVE #2 - OPEN

location of the front. This indicates a smooth meniscus did not occur there either since light would have been reflected away rather then back toward the observer. As the dimension of the meniscus increases, the pressure drop along the groove decreases along with the value of Q_{liq}. Hence, the lower experimental values for Q_{liq} should not be unexpected. More will be said in a later section about the geometry of the fluid front.

Dryout Front Movement.

In certain of the experimental runs, enough heat energy is transferred to the fluid to cause it to back off from the end of the groove, as discussed in the previous section, since capillary pumping is unable to replace the evaporating fluid rapidly enough. The fluid front response to a change in the heat transfer rate after steady-state obtained is the topic of this section. Three conditions are investigated. First, the power is turned off completely. Second, the power is reduced to the value of $Q_{c,max}$ for the groove which is determined in other experimental runs. Third, the same apparatus is used without putting any heat into the plate. These cold runs give an indication of the movement of the front in a small groove without heat transfer. They also serve to isolate the geometry effects of each groove so that heat transfer effects can be determined.

Dryout Front Location Versus Time.

The cold plate results are shown in Figure 32. The front velocities for Groove #1 and Groove #3 are very close and fairly constant (straight line slopes.) At the end of Groove #3, the bottom of the groove slopes up with a radius equal to that of the saw blade used to cut the groove. This causes a delay in reaching the end of the groove since the groove must fill up before the front reaches the very end. This is reflected in the decrease in front velocity near x = 0 cm shown in the Figure 32. The other grooves were routed out with a milling tool so the end of the groove has a vertical wall. Clearly, Groove #2 has the slowest front movement, and it is also constant.

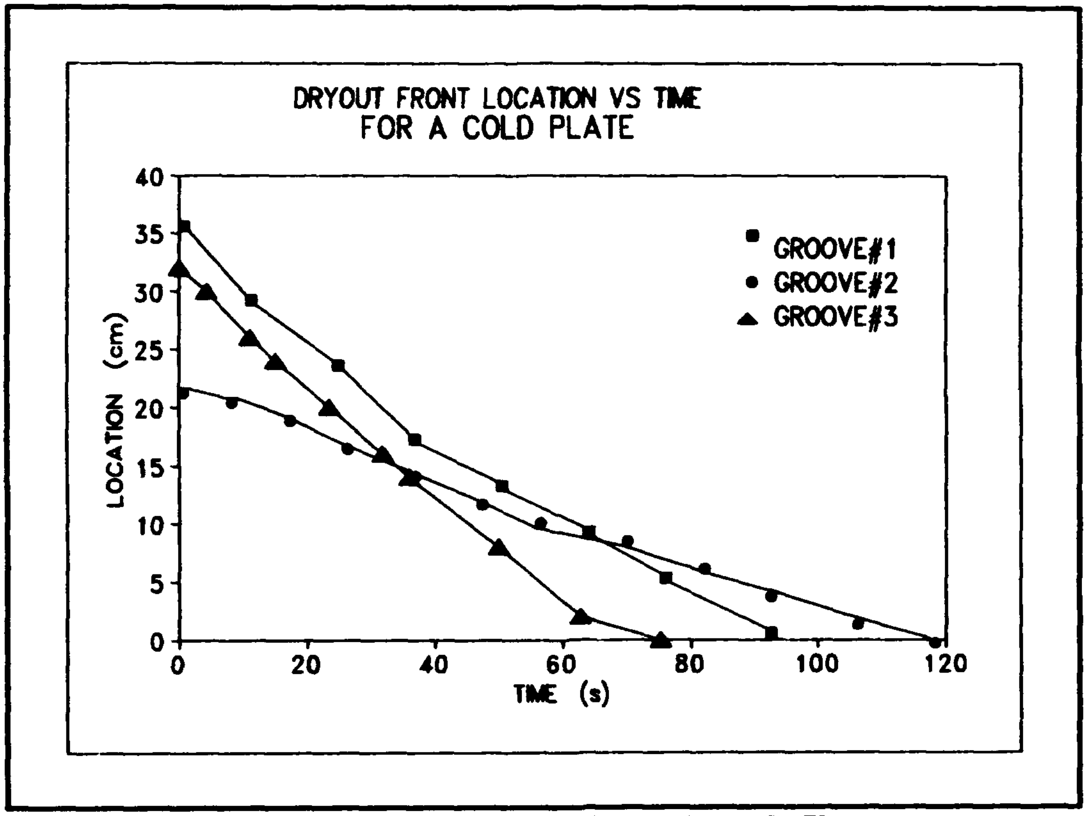

FIGURE 32. COLD FRONT VELOCITY

The results for the case where the power is shut down completely after steady state is obtained are shown in Figure 33. While the average velocity (distance traveled

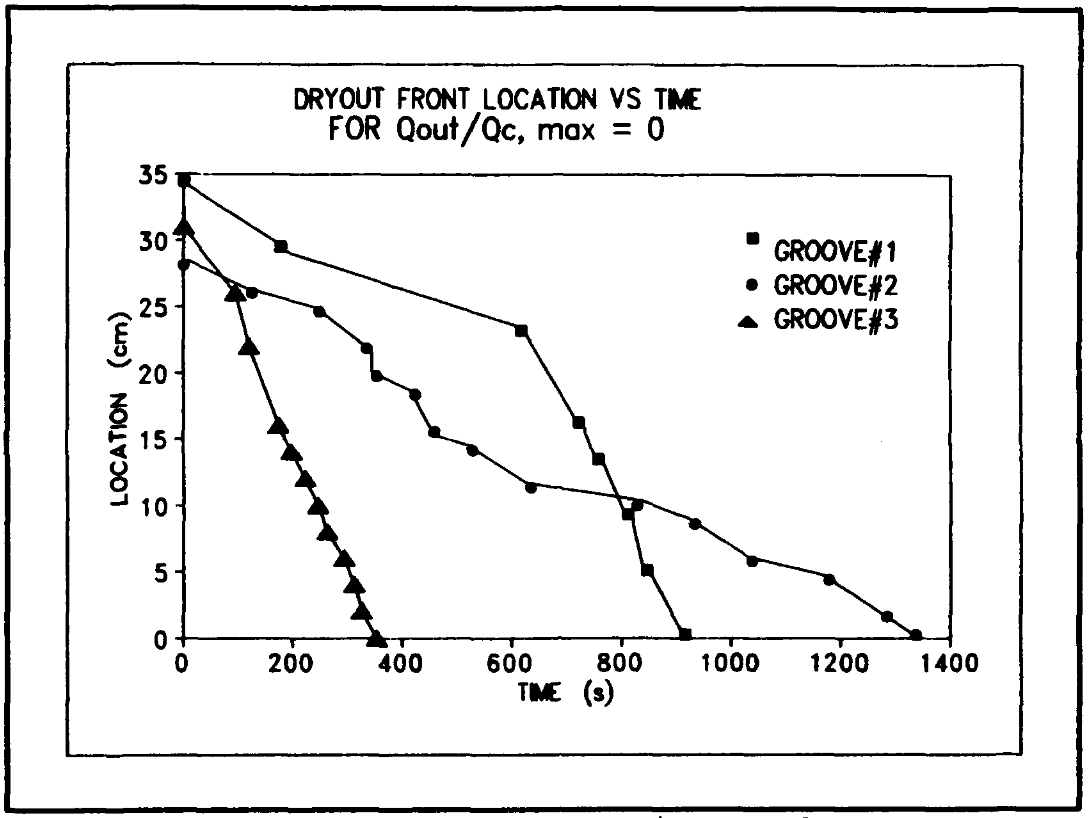

FIGURE 33. FRONT VELOCITY FOR $Q_{out}/Q_{c,max} = 0$

divided by the total time to rewet the groove) for Groove #3 is reduced by a factor of approximately five compared to the cold run, the line is straight as in the cold plate case. For Groove #2, the average velocity is reduced by a factor of approximately ten compared to the cold run, but as in the previous case, the velocity is fairly constant. The story for Groove #1 is different. The front does not move very much initially. But after some time, its velocity increases to match that of Groove #3. The velocities of Groove #1 and #3 are also similar in the cold plate case.

The results for the case where the power is reduced to the value of the capillary limit, $Q_{c,max}$, are shown in Figure 34. For Groove #2, the average velocity is about 75% that of the power off-case, but it is still fairly constant. For Groove #3, the velocity starts out fairly quickly (at about 60% of the power off case) but then slows down as the end of

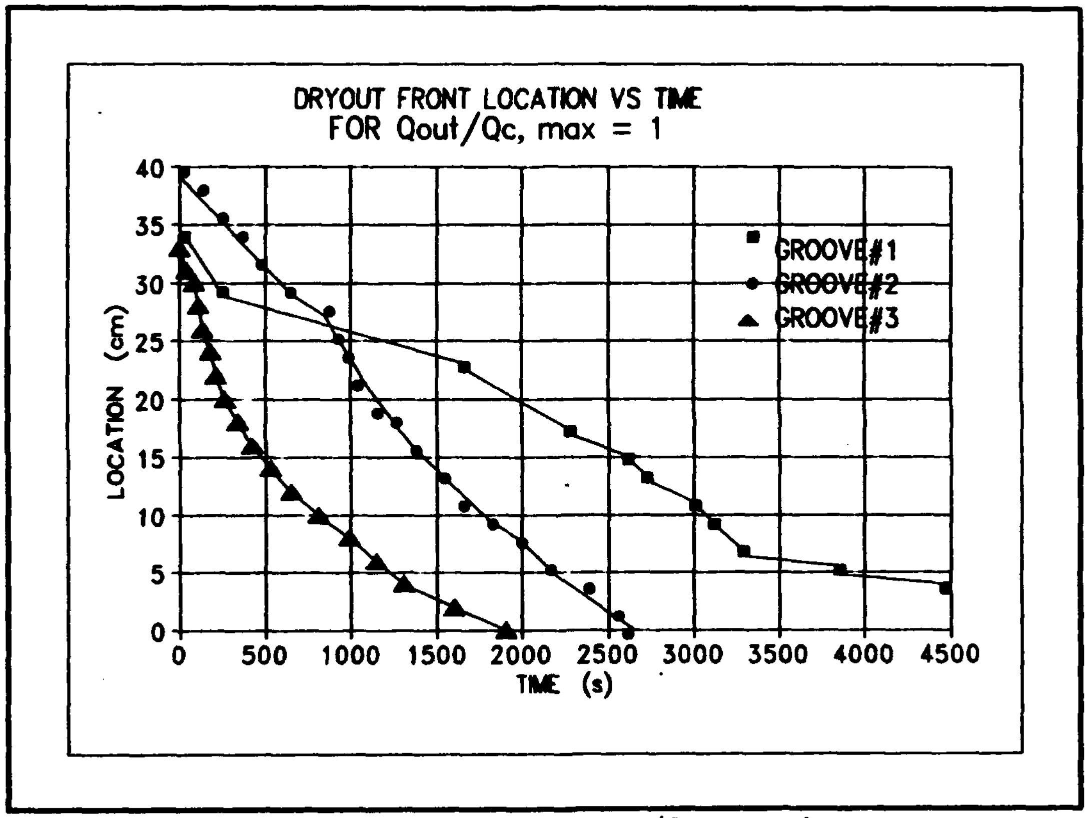

FIGURE 34. FRONT VELOCITY FOR $Q_{out}/Q_{c,max} = 1$

the groove is approached to a value approximately 10% of the power-down case. Part of the explanation has to do with the condition of the front in this case. As mentioned before, for

Groove #3 with a long dryout length, a five centimeter patch of liquid exists where nucleate boiling occurs. Boiling continues for a short time after power is turned down and facilitates moving the front back down toward the groove end. After boiling ceases, a slower front movement ensues. The same sort of boiling front exists in the power-down case but is not as effective in causing the front to move. Another consideration which is discussed more fully below involves the change in the thermal time constant as the plate cools down. This decrease in the plate cooling rate may inhibit rewetting.

In the case of Groove #1, the groove never rewets. The front moves quickly initially (probably due to the small amount of nucleate boiling in the corners) but then takes a long time to reach the vicinity of the groove end. This would support the arguments made in Chapter III regarding the rewet behavior of Groove #1. The inability to rewet is predicted because a larger radius of curvature dominates the flow for rewet than for dryout since the bottom of the groove is twice as large as the top of the groove.

Effect of Dryout Length on Front Velocity.

The results are shown in Figure 35. for the movement of the dryout front after power down to zero for Groove #2 and four different dryout length conditions. The legend shows the run designations from which the data are taken. Curves A and C are fairly straight. Curves B and D seem to be nonlinear. There is a remarkable agreement between the four tests for the average velocity of the dryout front (total length divided by total time.) These four tests were run on three different days. Consequently, some confidence in the results should be garnered. This may go to show that in the case of Groove #2, the cooling of the thermal mass of the copper plate has a strong influence on the behavior of the rewetting front, i.e.

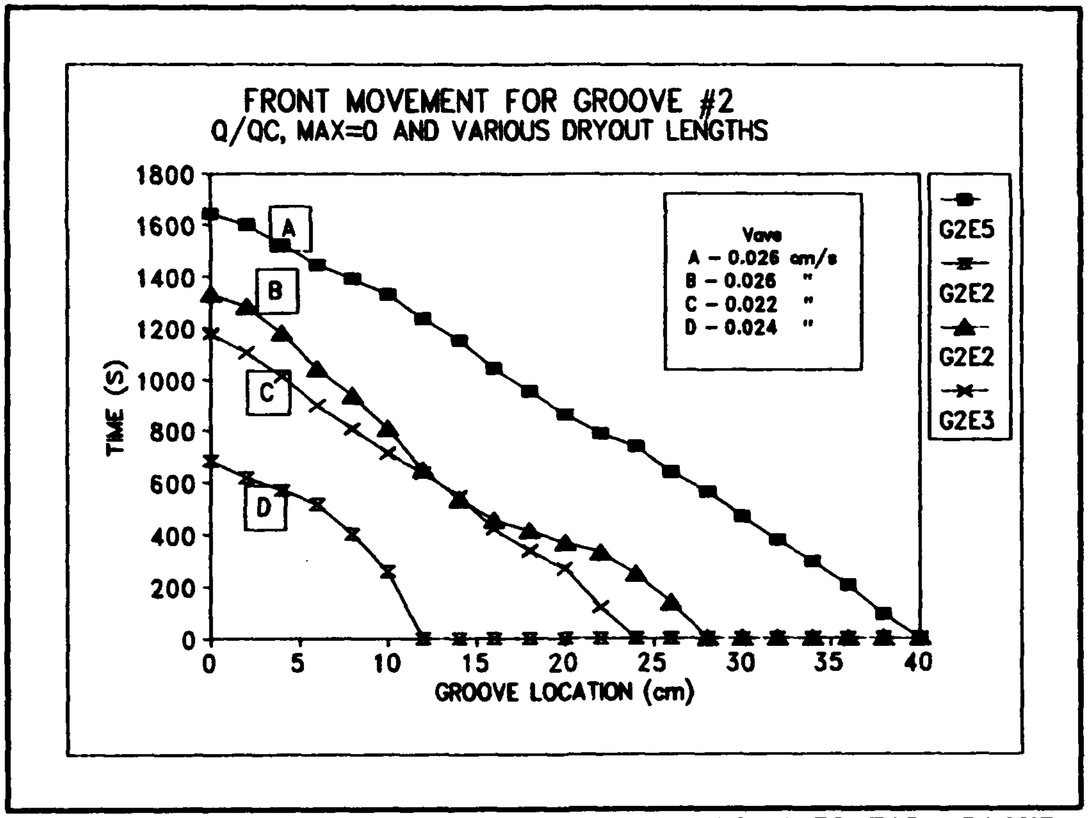

FIGURE 35. MULTIPLE FRONT VELOCITY RESULTS FOR GROOVE #2 AND $Q_{out}/Q_{c,max} = 0$

since the plate cools more slowly than the liquid can move, the plate cooling rate is the dominating phenomena. However, a nonlinear time dependence is expected since the groove followed the exponential lumped capacitance model so nicely, i.e. the average velocity for case A should have been larger than that for case C, but they are nearly equal.

Plate Temperature at Rewet Front Location.

Additional information was obtained pertaining to the front movement. In Figures 36. and 37., the temperature of the plate at the location of the liquid front as the groove is rewet is shown for the hot plate experimental runs discussed above. It is stressed that this is not the temperature of the fluid. The location and mounting techniques for the thermocouples are intended to measure the plate temperature as near to the liquid in the grooves as possible. Under steady state conditions, the liquid temperature is probably well approximated by the plate temperature at the liquid location, but transient conditions degrade the integrity of this argument. For Grooves #1 and #2, the temperature of the plate at the dryout front is highest when the front is far from the end of the groove, i.e. before the power is either shut off or reduced to $Q_{c,max}$. This is expected since for these grooves, quiescent evaporation (without boiling) is responsible for the

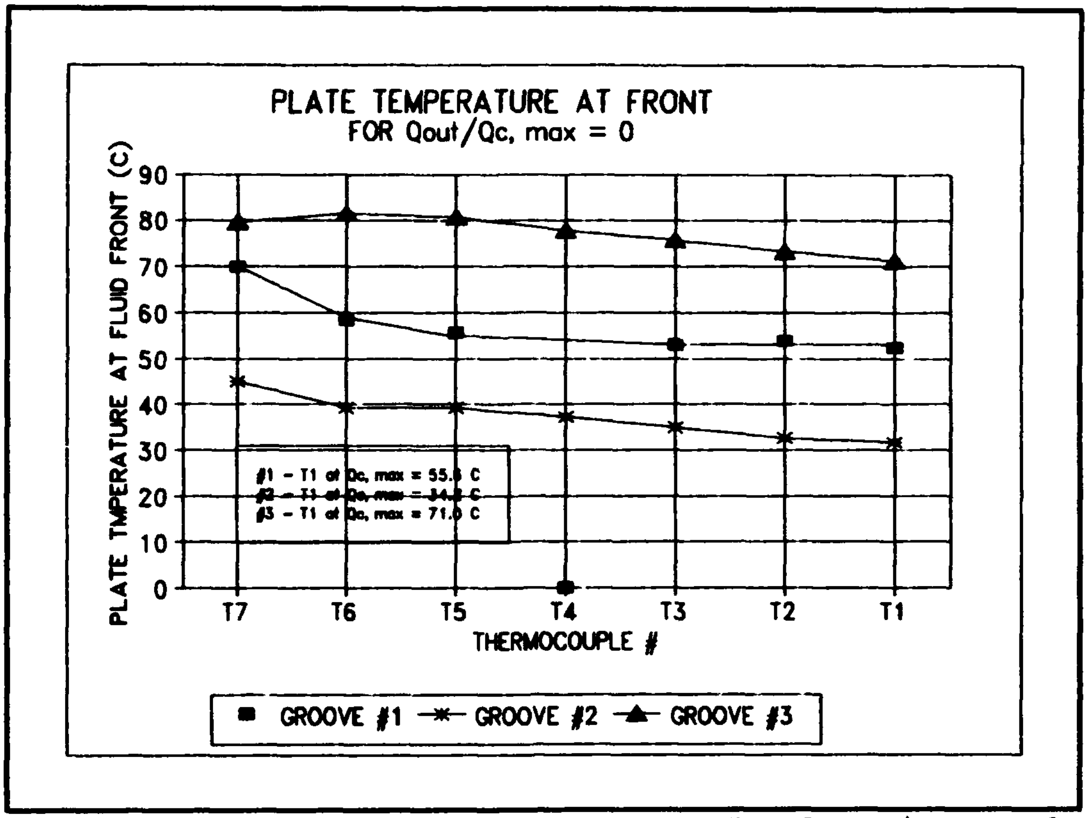

FIGURE 36. TEMPERATURE AT REWET FRONT FOR $Q_{out}/Q_{c,max} = 0$

liquid removal. The surface area for evaporation is smaller since the groove is dried out 30 - 40 cm from the end, hence the temperature must be higher to support a higher evaporation rate. As the front moves down the groove, the temperature of the plate decreases slowly to a minimum at the groove end. For Groove #3, the temperature at power-down and shortly thereafter remains fairly constant at the boiling point of the ethanol ($T_{b.p.}$ = 78°C.) Again this is expected since boiling is occurring at this location. Like the other grooves, the temperature then gradually decreases to a minimum at the

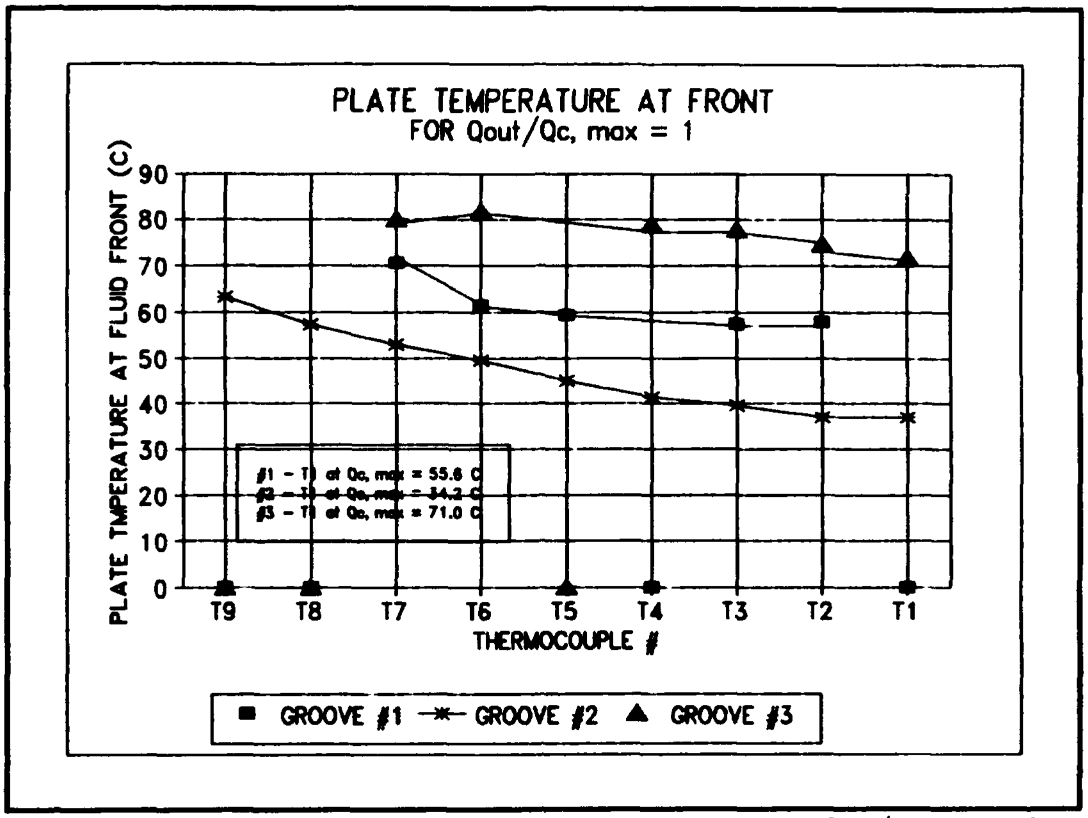

FIGURE 37. TEMPERATURE AT REWET FRONT FOR $Q_{out}/Q_{c,max}$ = 1

groove end. In <u>all</u> cases, the plate temperature as the liquid rewets the entire groove takes on the value at location T1 (See Figures 12. - 14.) for the steady-state $Q_{c,max}$ condition. This gives some confidence in the proximity to the correct value determined for $Q_{c,max}$ for each of the grooves.

Plate Cooling Rate.

The thermal time constant τ for each plate mentioned above is a function of the plate temperature since the cooling mechanism for the plate is primarily natural convection which relies on buoyancy for fluid motion. The buoyancy is derived from gradients in density due to a temperature gradient near the plate, i.e. between the plate and the surrounding temperatures. Since in each case the temperature of the plate in the evaporator section is different, τ will be larger in the cooler case since it is inversely proportional to h_c which is smaller for smaller temperature differences; τ is smaller under warmer conditions. In Table 6, the values of the average heat transfer coefficient along with the calculated value of the thermal time constant are shown for three conditions which are very near those for the front movement data discussed above. The thermal time constants can be used to calculate the time required for the plate to reach the temperature at rewet assuming the lumped capacitance model applies and the plate cooling mechanism is adequately described by the effective heat transfer coefficient given by Equation (15). This can be compared to the experimentally determined time required for the fluid to completely refill the groove and also to the time for the cold flow of liquid in the groove. The data show for the condition where the power is completely turned off, $Q/Q_{c,max} = 0$, the front arrives at location T1 at about the same time that the thermocouple at T1 returns to the same value recorded for that thermocouple when the condition for $Q_{c,max}$ obtained there. For the condition where the heat flux is reduced to $Q_{c,max}$, the lumped capacitance model gave poor results compared to the experimental data. The experimental time to return to the value at location T1 for $Q_{c,max}$ is given in Table 6. The plate returns to the appropriate temperature much more quickly than the fluid moves to refill the groove for Grooves #1 and #3. For Groove #2, the rewet time measures less than the time to cool the plate to 34.2°C. Since this plate is not very hot to begin with, the temperature difference between the plate and the surroundings which drives the cooling rate is small. Consequently, it is always in the region of the appropriate temperature although it takes a while to reach the specific value of 34.2°C.

Apparently some other phenomena besides the thermal conditioning of the groove is simultaneously occurring. One explanation involves the idea of chemical surface conditioning. As mentioned above, it appeared that as the front moves back down into the dried out portion of the

TABLE 6

COMPARISON OF PLATE COOLING AND REWET TIMES

	Groove #1	Groove #2	Groove #3
Tave (C)	56.5	31.1	86.9
h_c (w/m2-c)	18.1	14.5	22.8
τ (min)	24.9	28.0	23.1
Plate Time Using Thermal Time Constant Model Q/Qc,max=0	12.9	22.0	5.5
Plate Time Using Experimental Measurements Q/Qc,max=1	50.1	65.1	25.2
Fluid Time Experimental Q/Qc,max=0	15.3	25.9	5.8
Fluid Time Experimental Q/Qc,max=1	74.3	47.5	31.7
Cold Time (min)	1.55	2.52/3.58	1.09/1.16

[NOTE: The volumes of the plate used for the calculation of each τ were scaled by 0.78, 0.52, and .091 for grooves #1, #2, and #3 respectively to reflect the actual plate volume affected by higher temperatures.]

groove, a brown residue migrated into the liquid. If this residue/ethanol mixture is concentrated at the front, the bulk properties of the liquid may be changed so much that the value experimentally measured for $Q_{c,max}$ no longer applies. In Chapter II it was reported that the surface tension is a minimum at higher temperatures. Additionally, the existence of surface contaminants could decrease the wettability of the surface thus increasing the contact angle. A combination of these and other effects could reduce the capillary pressure difference to a point below that for the same groove which has not been exposed to dryout conditions for some time (around an hour for steady state.) This should not be considered a flaw in the experiment. In an actual closed heat pipe, it may be possible for certain chemical reactions to occur at the surface of the wick covered with the dried out residue of the working fluid, which may not occur in a wick which has not been dried out. Most chemical reaction equations include an "Arrhenius" term which is an exponential raised to the ratio of an activation energy to the kinetic energy or temperature, $e^{-(Ea/kT)}$. As the liquid chemically changes the conditions on the groove wall surface before advancing further down the pipe, it may be unable to replace the tainted liquid either due to evaporation since it is near its maximum rate at the front, most of the replacement liquid will be gone be the time it reaches the front, or because there is no mechanism for removing the tainted fluid from the front region. It cannot go forward because dryout conditions exist there. It cannot go backward because it would have to get around replacement liquid which is being pumped from the lower reservoir. Finally, chances are it cannot go up either (evaporate) since it survived the dryout; it must have a higher boiling point than the one which exists at the front.

Experimental Review

Having given the significant results of this project above, a review of the actual experimental technique is in order.

Apparatus.

In general, the apparatus worked as designed and the procedures employed were effective in obtaining data without much trouble. An objective of the design was to keep things simple and minimize the number of variables which might influence the results. The consistency and reproducibility of the data is a testimony to the attainment of this objective. However, there were some problems which deserve documentation for future reference.

The original choice of liquid was water. It's cheap, safe, plentiful, and has a high figure of merit (FOM) in the temperature range tested (See Figure 3.) ranging from 17,800 to 39,000 kW/cm^2. However, the contact angle for water with the copper plate, or rather the oxidized surface of the copper plate, was large, and water inconsistently wet the surface.

This interfered with the rewet behavior of the fluid. This feature is not reflected in the FOM (See Equation (1)) but other authors have reported similar results (Stroes, et al., 1990:360).

After reviewing alternatives, ethanol was chosen to replace water. Although its FOM ranged only from 1400 to 3000 kW/cm^2, it easily wet the copper plate, and was clear and relatively safe. A problem was encountered when ethanol was first used in the apparatus. A residue remained after the ethanol boiled off. This conclusion could be drawn because the groove did not dryout, even at temperatures well above the boiling point of ethanol. What did happen is boiling occurred at the location along the groove where the temperature was 78°C which is the boiling point of ethanol. The tubing manufacturer (Tygon) was contacted and they reported that their tubing is not recommended for use with ethanol. So, the tubing was changed, and steel or copper fixtures replaced plastic everywhere possible. This eliminated the problem since subsequent experimentation resulted in dryout and boiling at the location along the plate where 78°C prevailed.

Changing to ethanol had a negative effect on the plans for measuring the evaporation rate by using a difference in flow rates into and out of the lower reservoir. The evaporation rate at $Q_{c,max}$ was in the noise of the instrumentation for experiments with Groove #2. The instantaneous mass flow rate to the weight scale could be determined by software and DAS scale sampling, but this method had an uncertainty larger then the evaporation rate. Consequently, the value of the mass on the scale at ten minute intervals was used to get an average outflow rate from the lower reservoir after steady state prevailed. This reduced the uncertainty and was subsequently used for all three grooves.

Another aim of the experiment was to gather information at various angles of inclination to see their effect. Unfortunately, the plexiglass lower reservoir was not sturdy enough to handle the variations in plate position. The plate was much more massive than the plexiglass tank and the rubber dam was so stiff that the tank cracked, or seals gave out, causing leaks and precluded accurate measurements.

Since the inclination angle is an important factor in determining plate performance, the plate must be kept as flat as possible. At the outset of the experiment, the copper plate was flat. By the end of testing, the plate acquired a bowing which measured 3 mm at the center of the plate. Originally, clamps were used to keep the plate flat, but later they were removed because they did not seem to contribute anything except act as a source of heat leakage from the plate. Checking the flatness of the plate as time goes on is a good precaution to ensure thermal cycling is not warping dimensions.

Examination of the data for the runs in Grooves #1 and #3 indicates that some of the thermocouple data are irregular. As mentioned above, the thermocouples were calibrated and a bias for each was added to the software. However, as the experimentation proceeded, certain thermocouples gave measurements which were inconsistent and out of the range of uncertainty, e.g. T4 and T13 for Groove #1. There may have been inhomogeneities in the epoxy used to keep the thermocouples in the holes because at room temperature, all the grooves read the correct value of room temperature. Inconsistent thermal resistance or chemical degradation probably caused the irregularities.

The dimensions of much of the apparatus were deliberately chosen to be comparatively large to minimize the effects of transients. However, the resulting large thermal inertia caused long delays in achieving steady-state or making small adjustments to the power or flowmeter settings (usually 1 to 1½ hrs.) This contributed significantly to curtailing the testing on all five grooves. (See Figures 12.- 14.)

<u>Uncertainty Bands.</u>

In this section, a discussion of the methodology and documentation of the values for the uncertainties of the measurements is undertaken. In general, the methodology follows that given in Holman (1978:45)

$$w_R = [(\frac{dR}{dx_1} w_1)^2 + \ldots + (\frac{dR}{dx_n} w_n)^2]^{\frac{1}{2}} \tag{28}$$

where w_R is the total uncertainty in a result, R is the result, x_i is any measurement involved in determining R, and w_i is the uncertainty in the i^{th} measurement. Given this equation, Table 7 lists the values of the uncertainties in the measurements made for this project. In the graphs which appeared earlier, uncertainty bands were used only in those cases where the size of the uncertainty band is larger than the marker used to locate the data point on the graph.

In general, there were relatively few measurements to take; they were simple to do, and could be done accurately. It was sometimes difficult to define where the dryout front was due to microchannels or damp groove walls, but once the decision was made, the actual measurement using a ruler was easy. It is impossible to put an uncertainty band on the judgement call.

TABLE 7

EXPERIMENTAL UNCERTAINTY VALUES

RESULT	MEASUREMENT	SYMBOL	UNCERTAINTY	METHOD
VELOCITY (cm/s)	Length	L or x	± 1 mm	ruler
	Time	t	± 0.2 s	See 1.
POWER (W)	Current	I	± 0.03 A	equip. manual
	Voltage	V	± 0.03 V	equip. manual
HEAT TRANSFER (W)	Mass	M	± 0.011 gm	See 2.
	Mass Flow Rate	mdot	At 15 ± .000386 g/s At 25 ± .000589 g/s	See 3.
	Latent Heat	Hfg	±1 J/kg	Text
	Temperature	T	± 2°C	equip. manual

1. Determined by performing a series of reaction time experiments with a watch.
2. The dripping of liquid onto the scale which was sensitive (gradations to 0.001 gm) caused a fluctuating mass reading. The uncertainty was determined by performing a series of drip tests in which the maximum deviation from the steady state reading after a drop entered the flask was measured to be approximately 3 times the mass of a drop.
3. A series of calibration tests was performed in which the flowmeter was set at a particular level (either 15 or 25) and a large sampling of scale readings was gathered and used to determine the sample standard deviation (1 σ.)

Additional Computations.

Two additional comparisons can be made between experimental results and other information which reinforce the precision of the reported data.

Heat Flux Comparison.

A special test (T1) was done to determine a value of the average heat transfer coefficient for the plate with no fluid in the groove. Heat was input to the dry plate and the temperature distribution and power are recorded. Enough power is used to bring the plate to a temperature distribution which is the same as that for the condition of $Q_{c,max}$ for Groove #2. It takes 11.97 V at 1.025 A or 12.31 W to accomplish this. During the run designated G2E4, the rate of energy input to the plate (See Appendix G2E4 at t = 211.5 minutes) was 13.3 V at 1.14 A, or 15.16 W. The value of Q_{dryout} determined from mass flow rate measurements is 2.78 W. This should be the difference between the rate of energy measured in experiments T1 and G2E4. Adding 2.78 W to the result of experiment T1 gives 15.09 W which is in very good agreement with experiment G2E4.

Reynolds Analogy Comparison.

In Chapter III, the theory is developed for utilizing Reynolds analogy and a value for the heat transfer coefficient to estimate the evaporation rate. This calculation can be carried out as described and compared to some data from run designation G2E2. For a plate temperature of 34.2°C, the measured value of Q_{dryout} is 2.78 W. Depending on the surface area chosen, the Reynolds analogy approach gives an answer of 1.69 to 2.66 W (See the Appendix.) These numbers are based on evaporation only in the evaporator length. The smaller number is based on a flat surface while the larger number is based on a meniscus (semi-circular surface) for the entire length of liquid, so the correct value should be in between somewhere. An argument can be made that additional evaporation takes place in the adiabatic region between the reservoir and the evaporator, some of which is at an elevated temperature (the reservoir is kept covered to limit losses.) Using a longer surface length would extend the range to encompass the value determined by measurement. A larger experimental value should be expected due to drafts and other mass transfer enhancements and losses which are not accounted for by a heat transfer coefficient, e.g. a small amount of evaporation loss from the uncovered collection container on the weight scale.

Looking Ahead

This project provides some much needed data concerning heat flux induced dryout of grooves with capillary flows. More work needs to be done before the phenomena are understood and modeled with fidelity. In this section, an explanation of the data in the appendices and recommendations for improvements are recorded. This information is given here in order to facilitate utilizing the data for comparisons with analytical models and determining objectives and designs for future experimental work.

Description of the Appendices.

The appendices are made up of two types of information. The first is the actual data and data sheets acquired during experimentation. The second is a calculation work sheet which shows the approach, intermediate values, and thermophysical properties of the calculations used to make graphs and obtain comparisons for the data.

The data and data sheets go hand-in-hand. A listing of the run designations and their purposes is given in Chapter III. While the temperature and mass flow data are recorded on the DAS data records, other important information such as the timing of power downs, the level of power, and pertinent qualitative descriptions are contained in the data sheets. In order to have all the information about some point in the experimentation, the reader must refer to both. The format of the data records and the data sheets is straightforward. One clarification which should be made concerns a notation on the time in the data sheets. When timing the movement of the front, specific milestones are used to keep track of the progress down the groove. Since the computer only displays data every minute or so (more quickly when the temperatures were changing significantly), this could not be used for the fast transients. A stopwatch was used instead. The stopwatch time is normally 0.4 minutes ahead of the computer time. Therefore when the time is preceded by a "c" in the data sheets, this refers to the computer time. The stopwatch time is proceeded by a "w". The caution is reiterated to examine the thermocouple data for Grooves #1 and #3 before using it to make sure the readings are consistent.

Improvements to the Experiment.

1. An immediate improvement could be made by reducing the thermal mass. This would increase the amount and variety of data taken. This could be done by two approaches. First, make the plate smaller, at least in width. The long length was useful for varying dryout locations. Second, do a better

job of insulating the plate by suspending it in the webbing of the jig's I-beam and using the leveling table to flatten it out. Adding insulation to the bottom side and incorporating the heater in a reflective sheath could also help. Setting the plate and heater in a refractive brick material as an integral combinations would also accomplish this.

2. The measurement of the mass flow rate could be improved by taking any of three paths. First, add another scale/reservoir combination upstream of the lower reservoir to eliminate the flowmeter. Second, rewrite the DAS software to make the determination of the "instantaneous" mass flow rate to the scale over a longer period of time. Third, reduce the size of the lower reservoir. It took twenty minutes to bring the flow through the lower reservoir to steady-state. This reservoir was intentionally made large so that the liquid would remain at near room temperature to cool the end of the plate and transients would have little effect on the liquid surface level. But transients were not a problem, and the next recommendation addresses the liquid temperature.

3. In a heat pipe, all of the liquid is at approximately the same temperature. The lower reservoir in this experiment is made of plexiglass which is easy to see through and machine. These benefits are negated by the necessity of keeping the end of the plate cool to prevent melting the reservoir or rubber dam. If the lower reservoir were made of

a metal or glass container compatible with the working fluid, two more important benefits would be obtained. First, a heater could be placed beneath the reservoir (with a stirrer) and adjusted to keep all of the liquid at the same temperature. This would eliminate the uncertainties about the values of the thermophysical properties to use. Second, this container would be as stiff as the plate and the jig. It could be attached directly to the jig, and then pivoting the whole ensemble could be done to investigate angular dependence without causing the apparatus to fall apart.

4. The size of the groove itself should be made larger. The dimensions chosen for the plate in this project matched those in commercially available heat pipes used with water. The resulting small mass flow rates add to the uncertainty of the results. It is possible that using multiple grooves of the same dimension in parallel would improve this situation without adding new sources of uncertainty.

5. A clear or translucent material like glass or a thermal plastic used for the plate would allow better visual examination of the geometries and behavior in the groove. If a small amount of discoloration is added to the fluid, the location and shape of the dryout front cold be studied and photographed.

6. Water would be a better choice of fluid if some way could be used to make it more consistently wet the plate

material, e.g. a coating. Using a different material as suggested above in 5. might allow this to happen.

7. A small (milliwatt) helium-neon laser could be used to locate and study the dryout front. They are cheap, available, safe, and readily utilized for small dimension work.

8. There are two tools which would make the experimentation easier. First, design the grooves so that a special tool can be used to effectively and easily clean it. Using larger dimensions and eliminating sharp corners will also improve this situation. Second, incorporate an effective way to plug the groove being studied. There were numerous occasions when it would have been handy to accomplish this without resorting to toothpicks.

9. Finally, directly measuring the fluid temperature and putting hash marks or some other length determining device in the groove itself would improve the accuracy of the data. This would be hard to do without interfering with the experiment due to the small dimensions, and since surface properties are critical to the behavior.

VI. CONCLUSIONS AND RECOMMENDATIONS

Summary

An experiment was undertaken to study heat flux induced dryout in capillary grooves. A copper plate with grooves of three different geometries, square, rectangle, and trapezoid, was used with ethanol as the working fluid. The steady state and transient response to a dryout condition was described, discussed, and recorded.

Objectives Met

This project has attained the six objectives described in Chapter I.

1. A description of the operation of a heat pipe and the important parameters governing dryout is given in Chapter II.

2. An experiment was designed and implemented to study dryout behavior in small dimension grooves. The apparatus performed well and measured the intended behavior

3. The plate/fluid combination was characterized by physical dimensions, maximum capillary heat transfer, and

thermal time constant. These characteristics are compared to expected values from related governing theories.

4. Three different groove geometries (square, rectangle and trapezoid) were used to study their effects on the phenomenon.

5. The location of the dryout front for various conditions was measured and compared with theory.

6. The response of the system in terms of rewet velocity after dryout was documented for two cases, complete power down and reduction in power to the maximum capillary limit.

Conclusions

1. There is a difference between the capillary limit which is the amount of heat carried away by evaporation based on the maximum value of the capillary pumping, and the dryout power which is the rate of heat transfer to the groove which causes the liquid front to back away from the end of the groove. No justification can be given for using the hydraulic radius rather than some other critical dimension for determining the capillary limit for an open-ended pipe. In fact, the closed-ended theory, which is based on the critical radius of curvature for the groove, was in better agreement with the data. In any case, for quiescent evaporation, the liquid front is U-shaped and nearly vertically attached to the groove wall at dryout conditions. For boiling evaporation, the

liquid front fluctuated due to bubbling at the dryout condition. In neither of these cases is the front adequately described by a smooth, circular meniscus.

2. The geometry of the groove has a significant effect on the groove performance. Competing objectives must be balanced when manipulating geometries however. In the case of a trapezoid where the base is twice as large as the top of the groove, twice as much energy cold be absorbed before dryout, compared to the case of a square with the same size base and top. However, the trapezoid was also the worst geometry in terms of responding quickly to a dryout condition. In fact, some geometries may seem attractive because they have a high value for the capillary limit which prevents initial dryout of the groove. But once dryout occurs, recovery may be physically impossible without a large reduction in power and a long period of delay.

3. The location of the dryout front is not adequately described with present theories utilizing a simplified balance of shear stress and capillary pressure forces defined either by the critical dimension of the groove or by the hydraulic radius.

4. The rewet behavior of the grooves can be dominated by the thermal capacitance of the groove material. Large thermal masses which slow the rewet velocity may contribute to the inability to recover because a chemical reconditioning of the

groove walls occurs as the liquid moves back down to the end of the groove. The slower the liquid front moves, the more time for reconditioning. If the products of this reconditioning are concentrated in a small volume of liquid at the rewet front, critical properties like surface tension and contact angle may be adversely affected, reducing the capillary pumping capability of the apparatus.

5. There are two types of dryout mechanism. One is a quiescent evaporation which loses fluid over a large length of groove liquid. The other is a boiling evaporation where the loss of fluid is concentrated in a smaller region of the liquid. The boiling front is stable but complicates determining the appropriate radius of curvature for defining the capillary pressure difference. The agitation of the bubbling helps initiate a rapid recovery from dryout once the power is reduced. The dryout front for quiescent evaporation is stable for a wide range of locations since the surface area for evaporation is so spread out.

6. The phenomenon of heat flux induced dryout in capillary grooves is amenable to examination without significant complications. Ethanol proved to be a good choice for the working fluid. Originally, water was the choice, but it inconsistently wet the copper plate. Care must be taken to choose tubing, groove material, and other equipment which is compatible with the working fluid.

Recommendations for Future Study

1. Various groove geometries in use today may be good for heat transfer performance and poor for rewetting ability. A study of groove geometries may isolate a design which optimizes one or both of these objectives. In particular, a semi-circular groove which minimizes the surface area to volume ratio, is a prime candidate for rewetting capability.

2. A good material science investigation would be to design a material or coating for metals which is inert to high temperatures and also improves the wettability of the surface. Even plastic materials could be identified with these characteristics for use in low temperature heat pipes.

3. A good way to reinforce the argument about dryout hysteresis would be to choose different geometries and carefully approach $Q_{c,max}$ from both directions, i.e. from a full groove and from a dried out groove. Then a comparison could be made to a theory about the magnitude of the difference between the capillary limit and dryout power.

4. A study of boiling dryout fronts would add to the theory of recovery. Determining an effective radius of curvature for capillary pumping, calculating the rate of evaporation and extent of bubbling, experimenting with the effect of boiling in initiating rewet movement are possible topics.

5. A number of strategies for improving the rewet response can be conceived based on the results of this study. Some are particularly interesting to spacecraft designers. For example, including a small charge of fluid in a canister attached to the heat pipe which sprays the dryout area after power is reduced may improve rewet. Something as simple as spinning the heat pipe or tipping up the condenser end may be more effective.

6. Using the same groove geometry in plates of varying volumes would be a good strategy for determining the effect of thermal capacitance on rewet times by causing the fluid to be in contact with wall residues for varying lengths of time. Changes in thermophysical properties of the front could be investigated.

7. It is possible that the angle of inclination could affect the value of the dryout power. An investigation of rewet response at various angles would address this issue.

8. An interesting study would be to utilize lasers and shadowing techniques along with an opaque fluid and a transparent groove to study front geometry. This would also permit high speed photography of the exact response of the dryout front to a change in power level.

Epilogue

The motivation for this research was a better understanding of the mechanisms which cause heat pipes to work. Heat pipes are worthy of study because they take advantage of natural phenomena to accomplish a critical task cheaply and simply. It is hoped that the efforts here have contributed in some small way to the knowledge and understanding of heat pipe operation, and opened the door for further research which will lead to optimal utilization of this technology.

APPENDIX A:

DATA SHEETS AND DATA RECORDS

RUN DESIGNATIONS:

T1/A
T4
T9
G2E2
G2E3
G2E4
G2E5
G2E6
G3E1
G3E2
G3E4
G1E1
G1E2
G1E3
G1E4

(See Table 4 for a description of the run designations and Page 116 for a description of this appendix.)

Grooved Plate Dryout Experiment Data Sheet

Date: 24 Jul 92 Time: 1500 Run Designation: T1/T1A

Runtime (sec)	Amps	Volts	Comments	Dryout Length
203	1.025	11.97	Hot run of the plate to get the heat transfer coefficients	
2905	2.198	25.61	Steady State -- Up power	
6267	3.233	37.78	Steady State -- Up power	
9028	0	0	Steady State -- Power down	
			T1A	
144	2.854	33.45	Ethanol in reservoir	
2328	0	0	T_h=76 C Power down	

RUN LETTER DESIGNATION: TI

DATE: 07-24-1992 TIME: 15:00:19

GROOVE NUMBER: 2

THE BAROMETRIC PRESSURE: 29.04 MM OF MERCURY

THE FLOWMETER SETTING IS : 0

THE PLATE ANGLE IS 0

LEGEND			
T0	T1	T2	T3
T4	T5	T6	T7
T8	T9	T10	T11
T12	T13	T14	T15

RUNTIME: 60.58203 (sec)

24.2	24.2	23.8	23.5
23.3	23.4	23.6	23.9
24.4	23.9	23.1	23.4
22.9	22.6	21.8	23.0

RUNTIME: 83.65234

24.2	24.2	23.6	23.5
23.2	23.4	23.6	23.9
24.1	23.7	23.8	23.3
22.5	22.6	22.3	22.6

RUNTIME: 143.6797

24.4	24.3	23.6	23.5
23.2	23.5	23.6	23.9
24.5	23.8	22.9	23.2
22.5	22.9	22.3	22.9

RUNTIME: 203.7109

24.4	24.2	23.5	23.5
23.3	23.2	23.6	23.9
23.3	23.8	23.7	23.6
23.2	22.6	22.5	23.0

RUNTIME: 263.75

24.4	24.2	23.6	23.3
23.3	23.5	23.4	23.8
24.5	23.9	23.7	22.7
22.8	22.8	21.7	22.8

RUNTIME: 323.7813

24.7	24.7	24.1	23.9
23.6	23.8	23.7	24.4
24.7	23.8	23.4	23.3
23.3	22.7	22.0	22.9

RUNTIME: 383.8086

25.2	25.0	24.4	24.2
24.2	24.1	24.4	24.4
25.0	24.2	24.0	23.1

RUNTIME: 3145.359 (sec)

37.3	37.9	34.5	36.7
37.1	36.6	36.5	34.5
35.3	34.2	30.3	28.1
29.5	25.1	23.2	23.0

RUNTIME: 3205.391

38.7	39.4	35.2	38.0
38.6	37.6	37.8	36.7
36.6	34.5	30.7	28.6
30.1	24.6	22.7	23.1

RUNTIME: 3265.43

39.9	40.8	36.8	39.3
40.0	39.1	38.8	37.4
37.9	35.6	30.7	29.2
31.5	25.4	22.8	22.6

RUNTIME: 3325.46i

41.1	42.2	37.9	40.9
41.2	40.3	40.5	39.6
39.0	36.5	32.7	29.9
31.6	25.5	22.7	22.9

RUNTIME: 3385.492

42.4	43.3	39.1	41.9
42.6	41.9	41.4	39.7
39.7	37.4	32.9	29.9
32.5	26.0	23.3	22.8

RUNTIME: 3445.531

43.6	44.6	39.9	42.9
43.9	42.7	42.5	40.6
40.0	37.6	33.1	30.2
33.4	26.1	23.1	22.9

RUNTIME: 3505.559

44.7	45.8	40.7	44.1
44.7	43.9	43.6	42.3
41.1	39.0	34.3	31.1

RUNTIME: 6267.102 (sec)

59.6	61.2	53.8	59.1
60.2	58.3	57.2	56.2
54.6	51.1	44.7	40.6
43.7	32.3	24.0	23.0

RUNTIME: 6327.141

60.3	61.9	55.1	59.2
60.7	58.8	57.6	56.4
54.6	51.7	44.6	40.5
42.7	32.2	24.8	23.2

RUNTIME: 6387.172

62.3	64.2	57.2	61.6
63.2	61.2	59.8	59.2
57.1	53.6	45.1	40.4
42.9	31.9	24.7	23.3

RUNTIME: 6447.199

64.4	66.4	57.8	63.6
65.7	63.5	62.4	61.0
58.8	55.0	45.8	41.1
43.0	32.3	24.7	23.2

RUNTIME: 6507.242

66.7	68.7	60.7	65.6
67.7	65.5	64.7	62.8
60.9	56.0	47.3	41.9
43.9	32.6	24.2	23.0

RUNTIME: 6567.27

68.5	70.9	63.2	67.9
70.0	67.5	66.3	65.1
62.0	57.2	48.1	42.7
44.6	32.8	24.9	23.3

RUNTIME: 6627.309

70.0	72.9	63.5	69.9
71.6	68.8	68.4	66.4
63.8	58.7	48.7	43.2

23.6	22.9	22.4	22.6
RUNTIME: 443.8516			
25.6	25.5	24.7	24.8
24.5	24.6	24.8	25.1
25.6	24.3	23.5	23.5
23.7	22.8	22.3	22.9
RUNTIME: 503.8789			
25.9	26.0	24.9	25.1
25.1	25.0	25.3	25.4
25.9	25.2	23.9	23.2
23.8	22.9	21.5	22.7
RUNTIME: 563.9219			
26.2	26.3	25.3	25.4
25.3	25.3	25.5	25.6
26.1	25.4	24.4	23.3
23.6	22.3	21.8	22.9
RUNTIME: 623.9492			
26.5	26.7	25.3	25.8
25.7	25.9	25.9	26.0
26.3	25.2	23.7	23.5
24.0	22.8	22.6	22.9
RUNTIME: 683.9805			
26.9	26.9	25.8	26.2
25.9	25.9	26.0	26.1
26.7	25.9	24.9	24.1
24.3	22.7	21.2	22.5
RUNTIME: 744.0195			
27.2	27.4	26.2	26.4
26.4	26.2	26.5	26.5
26.9	25.9	24.9	23.2
24.2	22.8	22.5	22.7
RUNTIME: 804.0508			
27.6	27.8	26.2	26.7
26.7	27.0	26.9	26.7
27.3	26.2	24.5	23.8
24.6	23.2	22.6	22.8
RUNTIME: 864.082			
27.9	28.1	26.8	27.3
27.2	27.0	27.0	27.2
27.3	26.3	24.4	24.4
24.8	23.2	22.1	22.9

33.0	26.1	23.1	22.9
RUNTIME: 3565.59			
45.7	46.7	41.8	44.8
45.6	44.4	44.2	42.7
42.2	39.0	34.6	31.7
34.2	26.6	22.5	23.0
RUNTIME: 3625.629			
46.5	47.6	41.4	46.0
46.6	45.4	45.1	44.3
42.8	40.3	35.4	32.2
34.0	26.3	23.1	23.0
RUNTIME: 3685.66			
47.3	48.4	42.7	46.5
47.2	46.0	45.9	44.8
42.7	40.7	35.4	32.5
34.3	26.9	23.1	23.2
RUNTIME: 3745.691			
48.1	49.1	42.8	46.9
48.2	46.6	46.5	45.7
43.9	40.6	35.7	32.7
34.8	26.9	23.4	23.0
RUNTIME: 3805.73			
48.7	50.0	42.2	48.1
48.9	47.7	47.0	46.2
44.9	41.9	36.4	33.5
35.9	27.7	22.5	22.9
RUNTIME: 3865.762			
49.4	50.8	45.2	49.0
49.7	48.5	48.0	47.0
45.4	42.1	36.9	34.1
36.9	28.0	23.1	22.7
RUNTIME: 3925.789			
50.2	51.4	44.2	49.3
50.4	49.2	48.7	47.4
45.6	42.7	37.3	34.3
36.8	28.1	23.0	23.0
RUNTIME: 3985.832			
50.5	51.8	44.9	49.9
51.0	49.5	48.6	47.8
46.5	43.5	37.8	34.4
36.6	28.1	23.1	22.9

45.1	33.1	24.1	23.3
RUNTIME: 6687.34			
71.8	74.5	67.0	70.8
73.4	70.6	70.0	67.7
64.8	59.8	49.3	44.3
45.9	33.4	24.8	23.1
RUNTIME: 6747.371			
73.4	76.0	68.1	72.9
75.3	72.5	71.1	69.2
66.3	61.2	50.8	45.1
46.8	33.2	24.7	23.2
RUNTIME: 6807.41			
75.1	77.8	69.3	74.9
76.8	74.0	72.3	70.5
67.5	62.0	51.7	45.6
48.0	34.2	25.1	23.3
RUNTIME: 6867.441			
75.8	78.6	68.4	75.8
78.3	74.8	73.8	71.3
68.1	62.8	52.6	46.5
48.0	34.5	25.2	23.3
RUNTIME: 6927.469			
76.7	80.2	68.7	77.2
79.7	76.1	75.0	72.7
69.8	64.2	53.7	47.3
48.9	34.6	25.1	23.1
RUNTIME: 6987.512			
78.3	81.5	70.8	78.1
80.7	77.4	76.2	73.7
70.6	64.7	53.8	47.6
50.0	34.7	25.2	23.3
RUNTIME: 7047.539			
79.3	82.8	71.4	78.8
81.9	78.9	76.7	74.7
71.6	66.0	53.8	48.2
50.8	35.0	24.6	23.1
RUNTIME: 7107.57			
80.3	83.7	72.8	80.1
83.0	80.2	78.3	75.6
72.4	66.6	54.6	48.9
51.8	35.4	25.2	23.1

RUNTIME: 924.1211

28.0	28.4	26.8	27.3
27.3	27.3	27.2	27.1
26.7	26.7	25.2	23.9
24.4	23.2	22.4	22.8

RUNTIME: 984.1523

28.3	28.6	26.8	27.7
27.5	27.3	27.4	27.3
27.7	26.6	24.8	24.5
24.9	23.0	22.3	22.9

RUNTIME: 1044.18

28.7	28.8	27.3	27.6
27.8	27.7	27.6	27.6
28.0	27.0	25.6	24.1
25.2	23.2	22.0	22.9

RUNTIME: 1104.219

28.8	29.1	27.4	27.9
27.9	27.9	28.0	27.9
28.2	26.9	25.8	24.4
25.1	22.8	22.6	22.8

RUNTIME: 1164.25

29.0	29.3	27.6	28.4
28.2	28.2	28.1	27.7
28.0	27.4	25.9	25.0
25.4	23.3	22.3	22.6

RUNTIME: 1224.281

29.3	29.5	27.6	28.5
28.5	27.9	28.2	28.3
28.5	27.3	26.2	25.2
25.2	23.1	21.7	22.7

RUNTIME: 1284.32

29.3	29.7	27.8	28.5
28.6	28.5	28.3	28.3
28.5	27.6	25.7	24.7
25.1	23.5	22.6	22.9

RUNTIME: 1344.352

29.4	29.6	28.2	28.9
28.7	28.6	28.5	28.3
28.4	27.9	26.2	24.9
25.4	23.4	22.4	22.7

RUNTIME: 1404.391

29.6	29.9	28.0	29.1

RUNTIME: 4045.859

51.1	52.5	44.9	50.2
51.5	50.2	49.7	48.5
46.9	44.2	38.5	34.9
36.3	28.3	23.1	23.0

RUNTIME: 4105.902

51.8	53.1	46.1	50.7
52.1	50.6	50.0	48.6
47.2	44.4	38.7	35.0
37.5	29.0	23.6	22.9

RUNTIME: 4165.93

52.3	53.7	47.6	51.1
52.4	50.9	50.6	49.4
47.8	44.5	38.9	35.6
38.0	29.0	22.8	22.7

RUNTIME: 4225.961

52.5	54.0	46.4	51.5
53.2	51.6	51.1	49.7
48.2	45.4	39.2	35.4
37.6	29.2	23.4	22.8

RUNTIME: 4286

53.2	54.7	48.2	52.5
53.4	51.8	51.1	49.9
48.5	45.9	39.4	36.3
39.2	29.1	23.1	23.1

RUNTIME: 4346.031

53.5	54.9	47.7	52.5
54.0	52.2	51.6	50.4
49.4	46.1	39.9	35.9
38.8	29.5	23.1	22.9

RUNTIME: 4406.059

53.9	55.5	48.7	53.1
54.2	52.5	51.8	50.7
49.2	45.7	39.9	36.6
39.3	29.6	23.8	23.2

RUNTIME: 4466.102

54.4	55.8	49.3	52.9
54.7	53.0	52.2	51.1
49.6	46.7	40.4	36.3
39.2	29.6	23.7	23.1

RUNTIME: 4526.129

54.7	56.2	48.2	53.6

RUNTIME: 7167.609

81.5	84.7	73.6	79.9
83.6	80.4	79.1	76.6
73.0	66.8	55.4	49.2
52.0	35.9	24.7	23.3

RUNTIME: 7227.641

81.6	85.4	73.6	82.1
84.7	81.6	79.7	77.8
74.0	68.3	56.6	49.9
52.1	35.7	25.4	23.4

RUNTIME: 7287.672

82.8	86.3	76.0	82.5
85.3	82.3	80.5	78.2
75.2	69.2	57.0	50.0
53.2	36.4	24.9	23.3

RUNTIME: 7347.711

83.2	87.2	75.9	83.5
86.2	83.0	80.2	78.9
75.8	70.0	58.5	50.7
52.7	36.8	25.3	23.3

RUNTIME: 7407.742

84.2	87.7	77.7	84.4
87.1	83.7	81.5	79.7
75.5	70.2	58.6	51.1
53.5	37.1	24.9	-8.6

RUNTIME: 7467.781

83.8	88.4	76.3	83.8
87.7	84.2	82.5	80.2
76.9	70.1	58.0	51.7
53.8	37.6	25.0	-71.4

RUNTIME: 7527.809

85.6	89.2	78.1	84.7
88.1	85.2	83.1	80.5
76.6	70.9	58.4	52.3
54.6	37.7	25.5	23.5

RUNTIME: 7587.84

85.6	89.4	79.1	85.8
88.7	85.5	83.9	80.8
77.0	71.4	59.3	52.6
55.7	37.9	25.4	23.6

RUNTIME: 7647.879

85.9	90.0	77.7	86.5

28.9	28.7	28.6	28.4
28.7	27.5	26.3	25.3
25.8	23.0	22.0	22.8

RUNTIME: 1464.422

29.9	30.2	28.2	29.3
29.2	28.8	28.8	28.8
29.2	28.2	26.6	25.6
26.0	23.5	20.8	22.5

RUNTIME: 1524.449

30.2	30.4	28.6	29.5
29.5	29.1	28.9	29.0
28.9	28.4	26.7	25.6
26.0	23.6	21.5	22.9

RUNTIME: 1584.492

30.3	30.6	28.6	29.5
29.5	29.5	29.2	28.9
29.2	28.2	26.9	25.5
26.0	23.8	22.5	22.8

RUNTIME: 1644.52

30.4	30.8	28.9	29.6
29.7	29.5	29.7	29.2
29.2	28.3	26.6	26.0
26.2	24.0	22.8	23.1

RUNTIME: 1704.551

30.5	30.8	28.8	29.9
29.7	29.4	29.6	29.4
29.5	28.2	27.0	26.0
26.6	23.5	22.3	22.8

RUNTIME: 1764.59

30.3	30.8	29.0	29.7
29.9	29.5	29.6	29.2
29.6	28.5	27.0	25.4
26.2	24.1	22.3	22.9

RUNTIME: 1824.621

30.7	31.1	29.2	30.0
30.0	29.7	29.7	29.6
29.8	29.1	26.9	25.3
26.3	24.3	22.7	22.9

RUNTIME: 1884.652

30.7	31.1	29.1	30.1
30.0	29.5	29.7	29.7
29.7	28.8	27.3	25.9

55.1	53.6	53.0	51.6
50.0	46.7	40.9	37.2
39.4	29.8	23.2	22.9

RUNTIME: 4586.16

55.2	56.5	49.9	53.8
55.1	53.3	53.1	51.6
50.5	47.5	41.1	37.1
39.9	29.7	23.8	23.2

RUNTIME: 4646.199

55.3	56.7	50.0	54.3
55.6	53.8	52.9	52.2
50.3	47.5	41.5	37.7
40.3	30.0	23.4	23.4

RUNTIME: 4706.23

55.6	57.1	49.8	54.3
56.2	54.1	53.8	52.4
50.5	47.8	41.0	37.7
40.1	30.3	23.8	23.1

RUNTIME: 4766.262

55.7	57.6	49.4	55.0
56.4	54.8	53.8	52.6
51.3	47.8	41.5	37.9
40.1	30.6	23.9	22.8

RUNTIME: 4826.301

56.2	57.8	50.0	55.0
56.6	54.7	54.0	52.6
51.2	47.8	41.5	38.2
40.9	30.4	23.4	23.2

RUNTIME: 4886.332

56.3	57.8	51.0	55.2
56.8	55.1	54.3	52.9
51.2	48.3	42.0	37.9
41.5	30.3	23.8	22.9

RUNTIME: 4946.371

56.2	58.1	49.5	55.5
57.1	55.4	54.4	53.3
51.4	48.3	41.5	38.2
40.7	30.7	23.5	23.3

RUNTIME: 5006.402

56.4	58.3	50.7	55.7
57.3	55.4	54.7	53.6
51.9	48.4	41.6	38.7

89.7	86.1	84.2	81.9
77.9	72.1	59.4	53.0
54.6	38.1	25.8	23.3

RUNTIME: 7707.91

87.1	90.7	78.1	86.4
89.9	86.2	84.8	81.7
78.1	71.6	59.8	53.6
56.1	38.0	25.5	23.5

RUNTIME: 7767.941

86.8	90.8	79.9	87.4
90.4	87.2	85.3	82.6
78.4	72.5	60.6	53.9
56.7	38.8	26.1	23.3

RUNTIME: 7827.98

87.5	91.4	78.6	86.9
90.7	87.7	85.5	82.7
78.6	72.3	60.8	54.0
57.0	38.9	25.8	23.4

RUNTIME: 7888.012

87.8	91.6	78.6	87.9
91.7	88.1	86.4	83.2
79.3	72.8	61.2	54.0
57.2	38.6	26.0	23.4

RUNTIME: 7948.039

87.7	92.0	80.2	87.9
91.9	87.9	86.5	83.5
79.4	73.3	60.7	54.2
57.3	39.0	25.9	23.6

RUNTIME: 8008.082

88.2	92.5	80.1	88.5
92.1	88.9	86.1	83.5
79.7	72.9	60.7	54.4
58.1	39.1	26.3	23.7

RUNTIME: 8068.109

88.7	93.0	79.2	88.7
92.2	88.3	87.3	84.0
79.9	74.1	61.3	54.6
57.9	39.2	26.3	23.8

RUNTIME: 8128.141

89.1	93.1	80.0	88.8
92.6	89.2	86.0	84.9
80.4	74.0	61.2	55.1

26.2	24.0	21.9	22.5

RUNTIME: 1944.691

31.1	31.3	29.3	30.3
30.1	30.0	30.1	29.6
29.4	28.9	27.4	26.3
26.5	23.8	22.6	22.8

RUNTIME: 2004.719

31.0	31.4	29.4	30.3
30.4	30.1	30.1	29.8
30.1	29.3	26.7	25.9
26.9	23.8	22.3	22.8

RUNTIME: 5186.5

31.1	31.6	29.6	30.5
30.6	30.3	30.3	29.8
30.4	29.0	27.6	26.4
27.0	23.9	22.4	22.6

RUNTIME: 2124.789

31.1	31.6	29.2	30.5
30.4	30.3	30.3	29.9
30.3	28.8	27.6	26.3
26.5	24.4	22.7	22.6

RUNTIME: 2184.82

31.3	31.7	29.7	30.6
30.5	30.4	30.6	30.1
30.6	29.4	27.4	26.5
26.5	24.6	23.0	22.7

RUNTIME: 2244.859

31.4	31.7	29.5	30.5
30.8	30.4	30.6	30.3
30.1	29.3	27.6	26.3
25.8	24.1	22.7	22.9

RUNTIME: 2304.891

31.4	31.8	29.6	30.8
30.9	30.7	30.2	30.3
30.6	29.5	27.7	26.4
27.4	24.6	22.0	22.6

RUNTIME: 2364.922

31.5	31.9	30.1	30.9
30.9	30.6	30.9	30.1
30.6	29.5	27.0	26.5
27.0	24.4	22.8	22.9

41.5	30.4	23.8	23.1

RUNTIME: 5066.43

57.1	58.5	51.3	55.8
57.3	55.6	54.6	53.9
52.4	49.3	41.9	38.3
42.0	30.8	23.3	23.2

RUNTIME: 5126.469

57.3	58.7	51.2	56.0
57.6	55.7	54.9	53.9
52.1	48.8	42.3	38.4
41.2	30.8	24.1	23.3

RUNTIME: 8308.25

57.3	59.0	52.2	56.7
58.0	56.1	55.0	54.0
52.6	49.6	42.5	38.6
42.3	31.1	24.0	23.2

RUNTIME: 5246.531

57.8	59.1	50.6	56.0
57.8	56.2	55.0	54.1
52.5	49.1	41.8	38.3
41.2	31.2	24.1	23.2

RUNTIME: 5306.57

57.8	59.3	50.8	56.9
58.1	56.5	55.8	54.1
52.4	49.3	43.1	39.2
41.4	31.3	24.1	23.0

RUNTIME: 5366.602

57.8	59.2	52.3	56.9
58.4	56.7	55.8	54.4
52.7	49.8	43.1	39.1
42.7	31.7	24.1	22.9

RUNTIME: 5426.629

57.4	59.5	52.0	56.3
58.5	56.0	55.1	53.9
52.5	49.3	42.6	39.1
42.4	31.2	24.3	23.1

RUNTIME: 5486.672

57.9	59.7	51.2	56.9
58.5	56.9	55.8	54.5
52.4	49.6	43.3	39.2
41.8	31.8	23.9	22.9

58.0	39.1	26.0	23.8

RUNTIME: 8188.18

88.8	93.1	80.9	89.4
93.3	89.1	87.6	84.9
80.9	74.7	62.9	55.3
58.7	39.0	26.0	23.5

RUNTIME: 8248.211

90.3	93.9	80.3	90.2
93.8	89.8	87.8	84.2
81.7	75.2	63.2	55.9
59.0	39.6	26.1	23.8

90.0	94.1	81.0	90.0
93.4	90.0	87.7	85.4
81.2	75.1	62.4	55.2
59.4	39.5	26.1	23.4

RUNTIME: 8368.281

90.0	94.2	80.8	89.8
94.0	90.0	87.9	85.7
81.2	75.0	62.4	55.5
59.4	39.8	26.6	23.7

RUNTIME: 8428.309

91.0	94.1	80.2	89.8
94.2	90.3	88.4	85.5
81.1	75.0	63.1	55.9
59.0	39.8	26.3	23.8

RUNTIME: 8488.352

91.3	94.8	80.7	89.4
93.9	90.3	88.4	85.7
81.4	75.0	63.1	56.2
59.9	39.7	26.5	23.7

RUNTIME: 8548.379

90.7	94.6	80.7	90.6
94.3	91.0	88.9	86.2
81.7	75.5	62.6	56.0
60.0	40.0	26.5	23.6

RUNTIME: 8608.41

91.2	95.1	81.7	92.0
94.8	91.3	88.5	86.4
81.9	76.0	62.9	56.4
60.9	40.2	26.6	23.6

RUNTIME: 2424.961

31.7	32.1	29.9	31.0
31.1	30.9	30.9	30.5
30.4	29.2	27.3	26.4
27.1	24.8	22.9	23.0

RUNTIME: 2484.992

31.5	31.9	29.9	30.8
31.1	30.6	30.7	30.3
30.6	29.2	27.9	26.8
27.3	24.4	22.4	22.7

RUNTIME: 2545.02

31.7	31.9	29.8	31.0
31.1	30.7	30.6	30.6
30.8	29.9	27.7	26.5
27.3	24.4	22.3	22.9

RUNTIME: 2605.059

32.0	32.3	30.3	30.9
31.2	31.1	30.9	30.8
30.7	30.1	28.3	26.7
26.7	24.8	22.9	22.7

RUNTIME: 2665.09

31.7	32.2	29.8	31.1
31.2	30.9	30.9	30.6
30.6	30.0	28.0	26.7
26.8	24.5	22.5	22.9

RUNTIME: 2725.121

32.0	32.3	29.9	31.4
31.5	31.0	30.9	30.8
30.9	29.7	28.3	27.0
27.4	24.6	22.3	33.6

RUNTIME: 2785.16

32.0	32.4	30.1	31.0
31.4	31.0	31.2	30.8
30.9	30.1	27.7	26.3
27.1	24.5	23.0	23.6

RUNTIME: 2845.191

32.0	32.4	30.4	31.2
31.4	31.2	31.2	30.6
30.6	29.8	28.2	26.9
27.4	24.5	23.0	22.9

RUNTIME: 2905.219

32.1	32.5	30.4	31.5

RUNTIME: 5546.699

58.3	59.8	52.1	57.2
58.8	56.8	55.9	54.6
53.1	49.5	43.3	39.8
42.6	31.5	24.0	23.0

RUNTIME: 5606.73

58.5	60.1	52.7	57.2
59.0	57.2	56.4	55.1
53.4	50.2	43.8	39.9
42.0	31.8	24.5	23.5

RUNTIME: 5666.77

58.4	60.1	51.8	57.6
58.7	56.9	55.9	54.7
53.1	49.5	43.8	40.0
42.8	31.4	24.3	22.9

RUNTIME: 5726.801

58.8	60.4	52.4	57.6
59.0	57.4	56.2	54.8
53.5	50.2	43.1	39.7
42.4	31.9	23.5	23.2

RUNTIME: 5786.84

58.7	60.4	53.1	57.8
59.3	57.6	56.5	55.3
53.7	50.5	43.4	40.0
42.5	31.9	24.4	23.1

RUNTIME: 5846.871

58.7	60.4	53.2	57.7
59.3	57.5	56.6	55.4
53.6	50.3	43.7	39.7
42.8	31.7	23.7	23.2

RUNTIME: 5906.902

59.0	60.6	51.9	57.7
59.2	57.5	56.6	55.4
53.8	50.4	44.0	40.1
42.1	32.1	24.0	22.9

RUNTIME: 5966.941

59.3	60.7	53.3	57.6
59.5	57.6	57.2	55.7
54.2	50.8	44.3	40.5
42.8	32.0	24.5	23.2

RUNTIME: 6026.969

59.2	60.7	52.9	57.9

RUNTIME: 8668.449

91.0	95.2	80.2	91.1
94.8	90.9	89.0	86.6
81.8	75.8	63.1	56.4
60.6	40.4	26.6	23.7

RUNTIME: 8728.48

91.2	95.3	80.7	91.7
94.9	91.2	89.3	86.8
82.3	76.0	62.8	56.3
61.1	40.5	26.8	24.1

RUNTIME: 8788.512

92.1	95.4	81.5	91.0
94.8	91.7	89.2	86.3
81.9	75.6	63.3	56.5
61.2	40.7	27.0	23.7

RUNTIME: 8848.551

92.1	95.3	81.3	90.7
95.0	91.6	89.5	87.2
82.6	76.1	63.5	56.5
61.3	40.4	27.1	24.0

RUNTIME: 8908.582

90.8	95.3	81.5	91.3
95.4	91.6	89.8	87.3
82.5	76.2	63.9	56.8
61.6	40.7	27.0	24.3

RUNTIME: 8968.609

91.2	95.7	81.9	91.6
95.7	91.7	89.4	87.0
82.5	76.3	63.8	56.8
61.7	40.9	27.3	24.1

RUNTIME: 9028.652

91.2	96.0	82.1	91.7
95.9	91.4	89.4	87.0
82.5	76.7	64.2	56.8
61.8	40.8	26.9	23.9

RUNTIME: 9088.68

90.8	95.2	81.2	91.7
95.0	91.2	88.8	86.4
82.0	75.7	63.6	57.4
61.5	40.8	27.0	-324.6

RUNTIME: 9148.711

87.5	91.3	78.1	87.3

31.5	31.4	31.2	30.9
31.2	30.3	27.8	27.1
27.6	24.5	22.7	22.7

RUNTIME: 2965.262

32.7	33.0	30.6	31.8
31.9	31.6	31.5	31.1
31.7	30.6	28.6	27.0
27.5	24.3	22.5	23.1

RUNTIME: 3025.289

34.0	34.7	32.3	33.5
33.8	33.3	33.4	32.3
33.1	31.9	28.4	26.6
28.2	24.9	23.0	23.0

RUNTIME: 3085.32

35.9	36.5	33.3	35.3
35.6	35.1	35.0	34.2
34.6	33.0	29.8	27.4
28.3	25.2	22.9	22.9

59.5	57.3	56.9	55.4
54.0	50.7	43.8	40.4
42.7	31.9	24.2	22.9

RUNTIME: 6087.0

59.1	61.0	52.2	58.5
59.8	58.0	56.7	55.7
54.2	50.8	43.8	40.5
43.0	32.0	24.1	23.3

RUNTIME: 6147.039

59.3	60.9	53.6	58.5
59.8	58.1	57.2	56.0
54.3	51.2	44.4	40.3
43.6	32.0	24.5	22.7

RUNTIME: 6207.07

59.2	61.0	52.4	58.6
59.8	58.1	56.6	55.8
54.1	51.0	44.0	40.8
43.7	32.2	24.1	23.3

90.5	87.4	84.9	82.5
78.2	72.8	62.5	56.6
60.2	41.2	27.3	-324.6

RUNTIME: 9208.75

84.1	87.4	76.1	83.5
86.4	82.9	81.3	78.7
75.0	70.4	60.9	56.2
58.6	40.9	27.6	-324.6

RUNTIME: 9268.781

80.1	83.3	72.5	79.0
82.3	79.3	77.5	75.0
72.1	67.8	59.2	55.0
57.1	41.0	27.1	23.8

RUNTIME: 9328.82

76.3	79.8	69.0	75.5
78.5	75.6	73.4	71.9
69.1	65.2	57.5	53.6
55.6	40.6	27.8	23.8

Grooved Plate Dryout Experiment Data Sheet Date: 9 Sep 92 Time: 1526 Run Designation: T4				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			Purpose is to calibrate thermocouples at around 80°C. (Secondary get flowmeter σ_{n-1}) at 15. Check how much power into plate at 80°C.	
3.4	2.607	30.49	Turned power on	
6.4	2.607	30.52	Checked power	
30.4	2.595	30.48	Checked power	
41.4			Note: At 15 flowrate: 37.5 drops/min. Accounts for 0.003 gm/sec variation in readings if you miss one drop	
57.4	2.992	35.17	Turned power up T_1=65°C	
71.2	2.990	35.16	Check!	
81.6	3.154	37.13	Turned up power	
83.6			Emptied flask	
			If $T/T_{\infty}=1-e^{-t/\tau}$ then τ=12.78	
93.0	3.153	37.13	Check	
98.4			Steady state Checking thermocouples	
			Add one minute onto data time	
111.4			T_1=85 add 108 min	
112.4	3.052	35.96	Dropped power	
136.8	3.060	36.01	T_1=84	
140.8	2.947	39.7	Changed P_0	

RUN LETTER DESIGNATION: T4

DATE: 09-09-1992 TIME: 15:31:46

GROOVE NUMBER: 2

THE BAROMETRIC PRESSURE IS 28.9 MM OF MERCURY

THE FLOWMETER SETTING IS : 15

THE PLATE ANGLE IS 0

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	SCALE
1.0	21.3	21.9	21.6	21.9	22.0	22.1	22.1	22.3	21.6	21.3	21.4	21.6	21.4	21.9	21.5	21.6	27.142
1.4	21.4	21.9	21.6	21.8	22.0	22.2	22.1	22.2	21.6	21.4	21.5	21.5	21.4	21.8	21.4	21.6	28.113
2.4	21.5	21.9	21.7	21.9	22.0	22.2	22.1	22.3	21.3	21.4	21.5	21.5	21.5	21.9	21.5	21.9	30.555
3.4	21.4	21.9	21.6	22.0	22.0	22.1	22.1	22.3	21.5	21.2	21.5	21.5	21.7	21.8	21.3	21.7	32.915
4.4	21.6	22.2	22.1	22.1	22.2	22.2	22.3	22.4	21.7	21.8	21.8	21.4	21.5	21.8	21.6	21.7	35.219
5.4	22.5	23.5	22.4	23.4	23.7	23.8	23.8	24.6	23.8	23.8	23.0	21.8	21.6	21.8	21.5	21.7	37.520
6.4	24.4	25.5	26.8	25.7	26.0	26.2	26.2	27.1	26.2	25.8	24.5	22.8	21.9	22.0	21.6	21.8	39.732
6.8	24.9	26.1	27.6	26.2	26.6	27.0	27.0	28.0	27.0	26.5	25.0	23.1	22.1	22.1	21.4	21.7	40.642
7.8	26.6	28.0	31.9	28.4	28.9	29.2	29.2	30.0	28.8	28.2	26.1	24.0	22.9	22.4	21.3	21.8	42.802
8.2	27.5	28.7	29.7	29.1	29.6	30.0	30.1	30.8	29.6	28.9	26.6	24.3	23.2	22.5	21.5	21.5	43.702
9.2	29.2	30.9	34.5	31.2	31.8	32.2	32.1	32.9	31.4	30.5	27.8	25.4	23.7	23.0	21.6	21.8	45.856
9.6	29.8	31.5	30.0	32.0	32.4	32.9	32.7	33.7	32.0	31.0	28.3	25.6	23.9	23.0	21.5	21.8	46.757
10.6	31.7	33.5	34.4	33.7	34.5	34.9	34.4	35.5	33.5	32.7	29.8	26.5	24.5	23.5	21.4	21.6	48.915
10.9	32.4	34.1	34.4	34.4	35.1	35.7	35.3	36.1	34.0	33.0	29.8	26.9	25.1	23.7	21.5	21.5	49.818
11.9	34.1	36.1	36.6	36.4	37.0	37.9	37.0	37.9	36.0	34.4	31.0	27.9	25.8	24.3	21.4	21.6	51.974
12.3	34.6	36.8	32.5	36.8	37.4	38.2	37.6	38.5	36.1	34.6	31.4	28.1	25.9	24.5	21.8	21.5	52.872
13.3	36.2	38.5	40.3	38.6	39.2	40.1	39.3	40.3	37.7	36.1	32.4	29.1	26.7	25.0	21.4	21.7	55.019
13.7	36.9	39.3	42.0	39.3	40.0	40.7	39.9	40.8	38.2	36.5	33.0	29.5	26.9	25.0	21.4	21.6	55.924
14.7	38.5	41.0	41.9	40.9	41.7	42.3	41.3	42.4	39.5	37.7	33.7	30.2	27.7	25.6	21.5	21.8	58.129
15.1	39.0	41.5	39.3	41.4	42.0	42.6	42.0	42.7	39.9	38.2	34.4	30.6	27.9	25.8	21.5	21.6	58.973
16.1	40.3	43.2	40.6	43.2	43.8	44.3	43.4	44.1	41.3	39.3	35.4	31.5	28.6	26.3	21.3	21.7	61.123
16.5	40.9	43.7	41.3	43.7	44.1	44.9	43.9	44.9	41.8	39.8	35.7	31.7	28.9	26.5	21.3	21.5	62.027
17.5	42.6	45.2	44.7	44.9	45.4	46.2	45.0	46.0	42.6	40.7	36.4	32.7	29.6	26.9	21.4	21.4	64.224
17.9	42.8	45.7	43.5	44.9	45.9	46.8	45.7	46.5	43.4	41.2	36.9	32.8	29.7	27.0	21.5	21.7	65.071
18.9	44.0	46.9	47.6	46.5	47.4	48.0	46.7	47.5	44.2	42.3	37.7	33.5	30.3	27.5	21.5	21.6	67.225
19.3	44.5	47.5	44.7	47.3	47.6	48.4	47.2	47.9	44.5	42.5	37.9	34.0	30.5	27.7	21.4	21.6	68.066
20.3	45.6	48.6	48.5	47.8	49.0	49.7	48.5	49.4	45.6	43.4	38.7	34.5	31.3	28.1	21.4	21.6	70.267
20.7	46.0	48.9	49.0	48.4	49.2	49.8	48.4	49.4	45.9	43.8	39.3	35.0	31.2	28.5	21.5	21.4	71.099
21.7	46.9	50.0	48.0	49.8	50.3	51.1	49.6	50.6	47.0	44.8	39.8	35.5	32.1	28.7	21.5	21.5	73.246
22.7	48.5	51.4	53.5	51.0	51.8	52.3	50.9	51.4	48.0	45.6	40.6	36.1	32.5	29.2	21.3	21.5	75.458
23.0	48.4	51.6	53.6	50.7	51.5	52.5	51.0	51.6	48.0	45.5	40.9	36.2	32.7	29.4	21.5	21.8	76.288
24.0	48.9	52.5	48.0	52.0	52.7	53.6	52.0	53.0	48.7	46.3	41.3	37.0	33.1	29.8	21.6	21.5	78.427
25.0	50.3	53.7	53.9	53.1	53.9	54.9	53.2	53.9	49.9	47.3	42.1	37.5	33.7	30.1	21.6	21.8	80.571
25.4	51.0	54.1	51.1	53.5	54.3	54.8	52.9	54.2	50.0	47.4	42.4	37.7	33.8	30.3	21.4	21.6	81.407
26.4	51.7	55.0	54.4	54.4	55.5	56.0	54.3	54.8	50.8	48.6	43.1	38.3	34.4	30.6	21.5	21.5	83.545
27.4	52.4	55.8	53.7	54.8	55.5	56.4	54.8	55.7	51.5	48.8	43.4	38.8	34.7	30.9	21.6	21.8	85.683

28.4	53.3	56.5	59.1	56.1	56.9	57.5	55.6	56.4	52.2	49.6	44.0	39.4	35.3	31.2	21.6	21.8	87.893
29.4	53.5	57.2	54.7	56.4	57.2	58.1	56.0	56.9	52.7	50.0	44.4	39.7	35.5	31.4	21.6	21.7	89.959
30.4	54.5	57.9	57.5	57.3	58.2	58.8	56.8	57.6	53.4	50.6	44.8	40.2	36.0	32.0	21.6	21.7	92.097
31.4	55.3	58.8	58.2	57.6	58.3	59.0	57.0	58.2	53.9	50.9	45.2	40.5	36.1	32.0	21.6	21.8	94.221
32.4	55.0	58.9	54.3	57.6	58.5	59.3	57.6	58.6	54.2	51.2	45.7	40.9	36.6	32.4	21.7	21.7	96.300
33.4	56.0	60.0	57.1	59.0	59.4	60.1	58.1	59.1	54.6	51.6	46.2	41.4	37.0	32.8	21.8	21.9	98.431
34.4	56.9	60.4	62.8	59.4	59.9	60.9	58.5	59.7	55.3	52.1	46.7	41.9	37.5	33.0	21.8	21.8	100.551
35.4	57.0	60.7	57.5	59.5	60.5	61.2	58.8	60.1	55.5	52.7	47.3	42.2	37.7	33.2	21.8	21.8	102.657
36.4	57.3	61.2	59.8	60.4	60.8	61.5	59.1	60.2	56.1	53.4	47.4	42.4	38.2	33.5	21.8	21.8	104.733
37.4	58.1	61.5	57.5	60.6	61.4	61.7	59.8	60.7	56.2	53.1	47.5	42.7	38.2	33.6	21.8	21.8	106.822
38.4	58.4	61.9	58.1	60.8	61.5	62.2	60.3	61.2	56.7	53.6	48.3	43.0	38.3	33.6	21.8	21.8	108.882
39.4	58.3	62.4	60.6	60.8	61.6	62.7	60.5	61.6	57.0	54.2	48.6	43.4	38.7	34.1	22.0	21.6	110.944
40.4	59.0	63.0	61.7	61.5	62.6	63.0	61.0	61.8	57.7	54.5	48.8	43.7	39.0	34.2	22.2	21.8	113.072
41.4	59.0	63.0	61.9	62.1	63.1	63.7	61.3	62.3	57.5	55.2	49.2	44.1	39.4	34.3	21.9	21.8	115.147
42.4	59.5	63.5	58.2	62.2	63.1	64.2	61.6	62.4	58.3	54.9	49.2	44.4	39.5	34.6	22.1	21.8	117.230
43.4	59.6	63.7	61.7	62.1	63.1	64.3	61.8	62.9	58.3	55.2	49.3	44.3	39.6	35.0	22.1	21.8	119.325
44.4	59.7	63.8	64.1	62.4	63.6	65.0	62.4	63.3	58.6	55.9	49.9	44.7	39.9	34.9	22.3	21.6	121.386
45.4	59.9	64.3	62.9	63.2	64.2	65.0	62.6	63.5	58.6	55.8	50.2	44.7	39.9	35.1	22.2	21.7	123.504
46.4	60.1	64.3	62.2	63.4	64.2	65.0	63.0	64.0	58.8	55.9	49.8	44.9	40.4	35.3	22.4	21.6	125.566
47.4	60.9	64.9	61.3	63.6	64.8	65.4	63.1	64.1	59.2	56.2	50.2	45.1	40.5	35.6	22.5	21.9	127.620
48.4	60.5	64.7	62.7	63.0	64.2	65.4	63.0	64.1	59.5	56.3	50.3	45.2	40.6	35.5	22.3	21.8	129.671
49.4	60.9	65.2	61.3	63.9	64.7	65.5	63.2	64.6	59.3	56.2	49.8	45.3	40.9	35.8	22.3	21.6	131.665
50.4	61.5	65.4	62.7	64.4	65.9	66.1	63.9	64.4	59.7	56.5	50.3	45.5	40.9	36.0	22.5	21.7	133.715
51.4	60.9	65.0	61.2	63.9	64.9	66.4	63.8	64.7	59.9	57.0	50.8	45.9	41.0	36.1	22.5	21.6	135.703
52.4	61.5	65.6	63.2	63.9	65.4	66.5	63.5	64.7	60.1	57.3	50.8	46.0	41.1	36.1	22.7	21.8	137.681
53.4	61.6	65.7	64.1	63.9	64.9	66.3	63.7	65.0	60.1	57.0	51.1	45.9	41.2	36.2	22.6	21.7	139.736
54.4	61.6	65.7	61.7	64.4	65.0	66.2	64.3	65.1	60.4	57.1	51.0	46.3	41.5	36.4	22.6	21.8	141.656
55.4	61.5	66.0	63.9	64.4	65.4	66.2	64.4	65.4	60.2	57.5	51.1	46.4	41.5	36.6	22.7	21.6	143.631
56.4	62.3	66.3	64.5	64.8	65.6	66.5	64.2	65.2	60.4	57.4	51.2	46.4	41.5	36.5	22.8	21.9	145.611
57.4	62.1	66.1	63.2	64.4	65.8	66.8	63.9	65.4	60.4	57.9	51.7	46.5	41.8	36.7	22.9	21.8	147.590
58.4	62.3	66.6	61.6	65.4	65.9	66.9	64.7	65.4	60.8	58.1	51.7	46.7	41.8	36.7	23.0	21.9	149.501
59.4	62.3	66.9	64.6	65.4	66.4	67.6	65.1	65.9	61.1	57.9	51.7	46.7	42.1	37.1	23.0	21.8	151.401
60.4	62.7	67.6	64.3	66.4	67.1	68.4	65.9	66.9	62.4	59.4	53.0	47.4	42.3	37.2	23.1	21.8	153.247
61.4	63.4	67.8	66.4	66.6	67.6	68.2	65.6	67.3	62.6	59.7	53.2	47.5	42.4	37.1	23.3	21.7	155.047
62.4	64.6	68.7	66.8	67.4	68.1	69.0	66.6	67.7	63.3	60.1	53.3	47.9	42.6	37.4	23.4	21.7	156.860
62.8	64.7	68.8	67.7	67.5	68.4	69.6	67.3	68.5	63.7	60.4	53.4	47.9	42.9	37.5	23.4	22.1	157.575
63.8	65.1	69.4	66.7	68.1	68.9	69.7	67.5	69.0	64.4	60.8	53.8	48.4	43.0	37.7	23.3	21.7	159.475
64.8	66.1	70.3	67.6	68.5	69.5	70.7	68.3	69.7	64.5	61.4	54.2	48.8	43.5	38.0	23.6	22.1	161.374
65.8	66.0	70.6	69.4	68.9	70.0	71.6	69.3	70.4	65.5	62.1	54.8	49.0	43.7	38.3	23.7	21.6	163.211
66.8	66.8	71.2	68.4	70.1	71.6	72.1	69.4	71.1	66.0	62.9	55.7	49.4	44.0	38.3	23.6	22.0	165.105
67.8	66.8	71.6	67.7	69.7	70.8	72.3	69.5	71.6	66.7	63.1	55.9	49.7	44.2	38.5	23.6	21.5	167.018
68.8	68.0	72.5	69.2	70.4	71.5	73.1	70.2	72.0	66.7	63.2	55.7	50.2	44.5	38.8	23.7	21.9	168.925
69.2	68.0	72.5	69.5	71.2	72.0	73.2	70.2	72.0	66.6	62.9	55.7	50.1	44.6	38.9	23.8	22.1	169.674
70.2	67.7	72.5	71.0	71.1	72.4	73.8	71.4	72.6	67.4	64.1	56.4	50.4	44.9	39.0	23.9	21.6	171.565
71.2	68.3	73.2	70.9	71.7	72.7	74.0	71.2	73.4	67.6	64.4	56.7	50.8	45.0	39.1	24.0	21.6	173.476
72.2	68.9	73.8	69.4	72.3	73.5	74.5	71.7	73.2	67.9	64.6	57.1	51.1	45.3	39.3	23.8	21.7	175.381
73.2	69.0	74.0	71.9	72.9	73.8	75.5	72.4	74.0	69.0	65.3	57.2	51.2	45.8	39.8	24.0	21.9	177.212
74.2	69.2	74.1	71.2	73.0	73.8	75.6	72.8	73.8	68.7	64.9	57.4	51.5	45.8	39.9	23.7	21.5	179.116
75.2	69.5	74.7	71.2	73.1	74.0	75.5	73.1	74.4	68.8	65.3	57.8	51.9	46.0	39.8	23.8	21.7	181.012
76.2	69.9	75.1	71.9	73.5	74.4	75.8	73.4	74.7	69.2	65.8	58.3	52.1	46.3	40.0	24.1	21.8	182.843

77.2	69.6	74.8	71.4	73.2	74.4	76.1	73.4	75.1	69.5	66.5	59.0	52.1	46.6	40.4	24.2	21.7	184.740
78.2	70.6	75.8	72.6	74.0	74.9	76.8	74.4	75.3	69.9	66.3	58.4	52.4	46.6	40.5	24.2	21.7	186.641
78.6	70.5	75.7	73.5	74.4	75.2	76.8	74.3	75.3	69.7	66.9	58.8	52.6	46.7	40.5	24.3	21.9	187.388
79.6	71.2	76.2	73.1	74.0	75.8	76.8	74.0	75.6	69.4	66.3	59.2	52.8	46.8	40.5	24.1	21.7	189.211
80.6	71.0	76.2	73.2	74.0	76.0	77.2	74.9	75.9	70.4	67.2	59.3	52.9	47.1	40.8	24.3	21.8	191.108
81.6	71.4	76.1	73.5	74.4	76.0	77.3	74.2	75.7	70.2	67.2	59.4	53.2	47.3	40.9	24.2	21.5	192.947
82.6	72.0	77.0	73.9	75.0	75.8	76.7	74.0	75.9	70.5	66.8	59.1	53.1	47.4	41.1	24.4	21.6	194.770
83.6	72.1	77.4	73.9	75.9	76.5	77.5	75.0	76.6	70.9	67.8	59.8	53.4	47.3	41.2	24.7	21.8	7.025
84.6	72.3	77.3	73.7	75.7	77.0	77.8	76.0	76.8	71.1	68.0	59.9	53.5	47.8	41.2	24.4	21.8	8.984
85.6	73.1	78.0	75.6	75.7	76.6	78.3	75.9	77.2	71.9	68.1	60.5	53.9	47.8	41.5	24.4	21.7	10.955
86.6	72.8	78.1	75.8	76.5	77.9	78.9	75.7	77.5	72.2	68.7	60.4	53.9	48.0	41.7	24.6	21.9	12.993
87.6	73.1	78.5	75.4	77.0	77.9	79.6	76.1	78.3	72.5	69.1	60.9	54.4	48.4	42.0	24.6	21.8	14.980
88.6	73.1	78.6	75.4	77.3	78.1	79.9	76.4	78.7	72.6	69.2	61.4	54.6	48.6	41.9	24.9	21.7	17.062
89.6	74.1	79.3	76.2	78.1	79.3	80.3	77.6	78.8	73.3	69.7	61.2	54.6	48.6	42.2	24.9	21.6	19.108
90.0	74.1	79.4	76.2	77.5	78.9	80.3	77.0	79.0	73.1	69.7	61.1	54.9	48.8	42.3	24.8	21.8	19.919
91.0	74.6	79.8	76.4	79.0	80.0	80.9	78.3	79.6	73.9	70.1	61.9	55.4	49.2	42.4	25.0	21.9	22.028
92.0	75.4	80.4	76.5	78.3	79.3	80.6	78.2	80.0	74.1	70.5	62.8	55.4	49.2	42.6	24.9	21.5	24.138
93.0	75.8	81.1	77.2	78.6	80.3	81.2	78.6	80.2	74.8	70.7	62.5	55.6	49.2	42.4	25.0	21.8	26.236
94.0	76.0	81.1	78.9	79.6	80.5	82.0	79.4	80.7	74.7	71.2	62.6	55.8	49.5	42.7	25.2	21.9	28.276
95.0	75.6	81.3	76.9	79.5	80.7	82.6	78.8	81.1	75.2	71.5	62.6	55.7	49.5	43.0	25.4	21.7	30.380
96.0	75.8	81.4	78.9	79.6	80.6	82.0	79.0	81.2	74.9	71.4	63.2	56.2	49.6	43.2	25.4	21.7	32.486
97.0	77.2	82.1	78.7	80.0	80.9	82.6	80.0	81.6	75.2	70.6	62.9	56.5	50.0	42.9	25.2	21.9	34.595
97.4	76.8	82.1	77.0	80.4	81.1	82.7	79.5	81.5	75.8	71.5	63.2	56.5	50.2	43.0	25.3	21.7	35.410
98.4	77.1	82.2	80.3	80.4	81.5	82.6	80.4	81.8	75.8	71.9	63.5	56.7	50.1	43.4	25.4	21.7	37.511
99.4	77.6	82.6	79.9	81.2	81.9	83.1	80.6	81.9	75.6	71.8	63.1	56.6	50.4	43.5	25.5	21.8	39.560
100.4	77.6	82.6	79.7	81.4	82.2	83.4	80.2	82.1	76.1	72.1	63.3	56.6	50.5	43.5	25.6	21.8	41.654
101.4	77.4	82.9	79.6	81.3	82.2	83.8	81.1	82.7	76.3	72.8	63.9	56.7	50.8	43.5	25.5	21.9	43.725
102.4	77.9	83.4	78.5	81.9	83.0	83.7	81.3	82.4	76.3	72.4	63.5	56.8	50.5	43.7	25.6	21.9	45.785
103.4	77.8	83.4	79.8	81.7	82.8	84.0	80.8	82.5	76.5	72.5	64.0	57.0	50.8	44.1	25.7	21.9	47.882
109.0	78.7	84.0	79.0	82.1	83.4	84.7	81.5	83.7	77.2	73.1	64.5	57.7	51.3	44.1	25.9	21.8	56.613
109.4	79.6	84.3	80.6	83.1	84.2	85.3	81.9	83.4	76.9	73.3	64.8	58.0	51.7	44.3	26.0	21.9	57.359
110.4	79.3	84.6	82.0	82.9	83.6	85.3	82.6	83.6	77.1	73.2	65.3	57.8	51.4	44.4	26.2	21.9	59.389
111.4	79.0	84.6	81.1	83.1	84.7	85.6	82.3	83.7	77.4	73.3	64.8	58.0	51.7	44.7	26.2	22.0	61.424
112.4	79.4	84.7	80.8	82.5	83.3	85.3	82.4	83.4	77.6	73.5	65.0	58.3	51.6	44.6	26.5	22.2	63.455
113.4	78.8	84.3	80.4	82.3	83.4	85.1	82.0	83.5	77.7	74.1	65.4	58.4	51.9	44.6	26.4	21.9	65.412
114.4	79.4	84.7	81.5	82.9	83.7	85.0	82.2	83.9	77.9	74.1	65.4	58.1	51.8	44.9	26.6	22.0	67.359
115.4	79.7	85.1	80.8	83.6	84.6	85.9	82.8	84.0	77.6	73.3	64.0	58.3	52.0	45.0	26.6	22.0	69.316
116.4	79.1	84.8	80.9	82.8	84.3	85.8	83.1	83.7	77.3	73.4	64.5	58.2	52.1	44.9	26.6	21.9	71.274
117.4	79.3	84.8	80.9	83.0	84.2	85.3	82.3	84.1	77.7	73.5	65.0	58.4	52.1	45.1	26.5	21.8	73.230
118.4	79.3	84.8	80.3	82.6	84.6	85.8	83.3	83.9	77.5	74.0	65.0	58.3	51.9	45.2	26.7	21.9	75.148
119.4	79.2	84.2	80.0	82.8	84.4	85.6	82.0	83.6	76.8	73.6	64.7	58.4	51.8	45.0	26.6	21.9	76.991
120.4	79.2	84.3	80.1	82.7	83.4	85.2	82.2	83.5	77.1	73.2	64.9	58.5	52.1	45.1	27.0	21.8	78.915
121.4	79.1	84.4	74.0	82.2	83.5	84.6	81.0	83.7	77.1	73.2	65.3	58.3	52.1	45.1	26.6	22.0	80.835
122.4	78.8	84.6	61.2	82.2	83.1	84.8	82.0	83.6	77.2	73.5	65.5	58.3	52.2	45.2	28.5	22.0	82.753
123.4	78.7	84.4	49.2	82.2	83.4	84.5	81.4	83.3	76.9	73.3	65.0	58.5	52.3	45.3	26.8	21.9	84.596
124.4	78.9	84.2	80.8	82.1	82.8	84.5	81.6	83.0	76.9	73.2	64.8	58.5	36.0	45.4	27.0	22.1	86.518
125.4	79.0	84.6	79.4	81.9	83.1	84.1	81.5	83.2	77.1	73.1	65.0	58.4	19.7	45.5	27.4	22.0	88.367
126.4	78.8	84.4	80.6	82.5	83.1	84.4	81.7	82.9	77.0	72.8	64.5	58.5	52.2	45.4	27.3	22.1	90.217
127.4	78.4	83.9	80.4	81.7	83.4	84.9	82.3	83.4	77.1	73.3	64.6	58.5	52.1	45.6	27.3	21.8	92.065
128.4	79.4	84.5	79.9	82.7	83.8	84.9	81.3	83.4	77.0	73.3	65.0	58.3	35.5	45.5	27.5	22.0	93.906

128.8	79.1	84.0	79.8	82.9	83.8	85.1	82.1	83.3	76.8	72.8	65.0	58.4	52.1	45.3	27.3	22.0	94.595
129.8	78.3	84.0	81.3	81.8	83.7	85.0	82.2	83.4	76.9	73.1	65.2	58.4	52.2	45.4	27.4	-326.0	96.444
130.8	78.7	84.0	80.8	83.0	83.6	85.0	81.4	83.3	77.0	73.2	65.2	58.4	52.2	45.4	27.5	-326.0	98.281
131.8	77.8	83.9	79.9	82.0	83.2	85.0	82.1	83.0	77.1	73.5	65.6	58.5	52.4	45.7	27.5	-326.0	100.063
132.8	78.6	84.1	80.4	81.9	83.7	85.1	81.9	83.0	77.1	73.7	65.3	58.6	52.3	45.7	27.5	-326.0	101.839
133.8	78.7	84.1	80.5	82.0	83.1	84.9	81.3	83.2	77.4	73.8	65.3	58.5	52.4	45.7	27.7	-326.0	103.675
134.8	78.4	84.0	80.8	82.1	83.2	84.9	81.7	83.1	77.1	73.5	64.9	58.5	52.3	45.7	27.7	-326.0	105.455
135.8	78.5	84.2	80.2	82.5	83.6	84.6	82.0	83.2	77.1	73.7	64.7	58.6	52.4	45.7	27.7	-326.0	107.156
136.8	77.6	83.4	81.4	81.8	82.6	84.9	81.1	83.3	76.2	73.1	65.3	58.6	52.6	45.8	27.9	-326.0	108.924
137.8	78.4	83.8	79.7	82.0	83.4	84.8	81.7	82.8	76.8	73.4	65.4	58.5	52.3	45.8	27.8	-326.0	110.696
138.8	78.8	83.8	80.2	82.5	83.7	84.8	82.0	83.2	76.7	73.3	64.9	58.6	52.9	45.9	27.9	-326.0	112.397
139.8	78.1	83.7	80.3	80.9	82.3	84.6	81.8	83.2	76.8	73.7	65.0	58.6	52.4	45.9	28.1	-326.0	114.089
140.8	78.4	83.8	80.7	82.7	83.7	85.1	82.3	83.4	76.7	73.5	65.2	58.7	52.5	45.9	27.9	-326.0	115.841
141.8	78.1	83.7	80.0	81.7	83.1	84.2	80.5	83.2	76.6	73.4	65.5	58.8	52.4	45.9	28.2	-326.0	117.688
145.0	77.6	83.3	79.9	81.7	82.5	83.6	80.5	82.4	76.7	73.0	65.1	58.6	52.6	46.1	28.2	-326.0	126.518
145.4	78.0	83.1	79.0	81.6	82.4	84.1	81.0	82.3	76.0	73.0	64.6	58.4	52.5	46.0	28.5	-326.0	127.273
146.4	78.1	83.3	79.6	81.1	81.7	83.5	80.3	82.4	76.1	72.6	64.6	58.3	52.6	45.7	28.3	22.0	129.267
147.4	77.8	83.1	78.8	80.0	81.6	83.9	80.7	81.8	76.0	72.0	64.5	58.4	52.5	46.0	28.6	22.1	131.193
148.4	78.0	83.1	77.8	80.3	81.9	83.7	80.6	82.4	75.9	72.4	64.6	58.6	52.4	46.0	28.9	22.1	133.173
149.4	77.8	82.9	80.3	80.4	81.3	83.0	79.9	81.8	75.5	72.3	64.9	58.5	52.5	46.3	28.7	22.0	135.163
150.4	78.1	83.0	80.5	81.2	82.1	83.7	80.4	82.4	76.0	72.5	64.6	58.6	52.7	46.1	28.6	22.0	137.157
151.4	77.4	83.1	79.2	81.2	81.8	83.7	80.6	82.2	76.1	72.3	64.9	58.6	52.7	46.3	28.8	21.9	139.145
152.4	77.6	82.8	78.8	81.0	82.5	83.9	80.8	82.4	76.1	72.7	64.9	58.7	52.7	46.3	28.9	22.1	141.111
153.4	77.7	83.2	79.9	81.4	82.1	83.9	80.4	82.6	76.2	73.0	65.1	58.6	52.8	46.5	28.9	21.9	143.076
154.4	77.7	83.1	78.6	81.4	81.9	83.5	80.7	82.5	76.0	72.5	65.1	58.6	52.8	46.4	28.8	22.0	145.050
155.4	77.7	82.7	78.6	81.2	82.1	83.9	80.8	82.4	76.4	72.6	64.5	58.6	52.6	46.3	28.9	-326.0	147.032
156.4	77.3	82.5	71.0	81.8	83.3	84.2	81.0	82.4	76.0	72.3	64.8	58.6	52.7	46.2	28.4	22.1	149.022
157.4	77.8	82.9	56.8	81.2	81.9	83.7	80.7	82.2	76.2	72.3	64.4	58.5	52.6	46.0	29.4	22.2	151.008
158.4	77.6	82.5	78.3	81.4	82.1	83.4	80.3	82.6	76.0	72.2	64.3	58.3	43.0	46.3	29.2	22.1	152.994
159.4	77.2	82.8	78.6	80.9	81.9	83.3	80.4	82.4	76.0	61.5	64.4	58.4	52.8	46.5	28.9	21.9	154.917
160.4	77.9	82.9	78.8	80.9	81.9	83.4	80.4	82.2	75.7	72.3	64.1	58.6	52.6	29.5	29.3	22.1	156.908
161.4	77.8	82.8	80.1	81.4	82.1	83.7	80.6	82.1	75.9	72.2	64.3	58.7	52.8	46.4	20.0	22.1	158.875
162.4	77.6	82.8	80.0	80.8	82.0	83.7	80.4	82.1	76.1	72.5	64.8	59.4	52.7	46.4	29.3	22.0	160.811
163.4	77.7	83.1	79.3	80.7	81.9	83.6	80.0	81.7	75.8	72.5	65.9	58.4	52.8	46.5	29.2	21.9	162.720
164.4	77.8	82.7	79.6	81.9	82.7	83.6	80.7	82.0	71.5	72.2	64.6	58.4	52.7	46.3	29.4	22.1	164.642
165.4	77.3	83.3	79.2	80.8	82.5	83.5	80.6	82.0	75.8	72.2	64.5	58.3	52.7	46.3	29.3	22.0	166.558
166.4	77.7	82.6	79.7	81.0	81.5	83.3	80.2	82.2	75.6	72.0	63.9	58.1	52.9	46.3	29.3	22.1	168.473
167.4	78.3	82.3	78.8	81.0	82.3	83.2	80.6	81.8	75.6	72.2	64.5	58.2	52.6	46.4	29.4	22.0	170.454
168.4	76.8	82.2	78.8	81.2	82.7	74.7	80.4	81.9	75.8	72.0	64.4	58.4	52.7	46.3	29.4	22.1	172.307
168.8	77.2	82.5	78.6	81.2	81.7	83.1	79.3	81.4	76.0	72.1	64.7	58.4	52.5	46.2	29.5	22.1	173.126
169.8	76.8	82.1	79.7	78.4	81.7	83.7	80.4	81.8	75.6	71.7	64.0	58.2	52.5	46.5	29.7	22.1	174.964
170.8	76.8	82.1	75.7	80.4	81.7	83.5	80.4	81.5	75.7	72.7	64.4	58.3	52.5	46.3	28.8	22.1	176.880
171.8	77.5	82.8	62.2	80.2	81.9	83.1	79.8	81.7	75.3	72.2	64.5	58.3	52.7	46.0	29.8	22.0	178.721
172.8	76.6	82.0	78.1	80.1	81.4	82.9	80.0	81.4	75.2	71.6	64.4	58.3	52.7	46.2	29.7	22.1	180.564
173.8	77.7	82.4	79.0	80.0	81.0	82.6	79.5	81.2	75.4	72.5	64.7	58.2	52.5	46.0	29.7	22.1	182.482
174.2	76.8	82.3	78.8	80.4	81.3	82.8	79.9	81.6	75.4	71.6	64.2	57.9	52.6	46.2	29.7	22.1	183.160
175.2	77.4	82.1	78.2	80.2	81.2	82.6	80.1	81.4	75.6	72.2	64.1	58.1	52.5	46.0	29.7	22.2	185.006
176.2	76.7	82.2	79.3	79.9	80.8	82.8	79.8	81.4	75.1	71.6	63.4	57.9	52.5	46.2	29.7	22.1	186.882
177.2	76.8	81.7	79.4	80.5	81.6	80.0	80.1	81.4	75.4	71.7	64.0	57.9	52.4	46.2	30.0	22.0	188.703

Grooved Plate Dryout Experiment Data Sheet

Date: 2 Oct 92 Time: 1450 Run Designation: T9

Runtime	Amps	Volts	Comments	Dryout Length
			This is a special run to claibrate thermocouples for Groove #1 and get some h_c data	
0	1.140	13.29	The power has been on for a while	
C4.4	1.140	13.32	Power Check	
C5.4	1.139	13.29		
C18.4	2.079	24.30	SS T_1=32 C, Upped power	
C58.6	2.074	24.27		
C67.6	2.067	24.22	Power Check T_1=55 C	
C71.6			Call this steady state! Power down. SSSUM = 0.58 Note: T_{14}=25	

RUN LETTER DESIGNATION: T9

DATE: 10-02-1992 TIME: 14:55:48

GROOVE NUMBER: 1

THE BAROMETRIC PRESSURE IS 29.011 MM OF MERCURY

THE FLOWMETER SETTING IS : 0

SCALE = 0.0

THE PLATE ANGLE IS 0 TIME IN sec T15 = 22.1 C

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14
60.4	30.8	30.5	30.4	30.4	31.9	30.4	30.3	29.7	29.3	29.3	27.5	26.1	25.4	24.1	21.7
83.7	30.9	30.8	30.6	30.6	32.1	30.7	30.4	29.8	29.3	29.5	27.7	26.2	25.6	24.5	21.8
143.7	31.0	30.8	30.7	30.5	32.2	30.6	30.4	29.8	29.4	29.4	27.7	26.2	25.6	24.6	21.6
203.7	31.3	30.9	30.9	31.0	32.5	30.9	30.6	30.1	29.7	29.8	27.9	26.4	25.7	24.7	21.9
263.8	31.4	31.2	31.0	31.1	32.5	31.0	30.7	30.2	29.6	29.9	27.9	26.4	25.9	24.8	21.9
323.8	31.3	31.1	31.0	31.1	32.5	31.1	30.8	30.0	30.1	29.8	28.0	26.6	25.9	24.6	21.9
383.8	31.6	31.5	31.3	31.2	32.7	31.3	30.9	30.2	29.8	30.0	28.1	26.7	26.0	25.0	21.9
443.9	31.7	31.6	31.2	30.8	32.7	31.3	31.1	30.3	30.4	30.0	28.2	26.8	26.1	25.2	21.8
503.9	31.9	31.7	31.6	30.9	33.1	31.5	31.3	30.5	30.5	30.3	28.2	27.2	26.3	25.4	22.1
563.9	31.9	31.7	31.5	30.9	33.0	31.6	31.3	30.7	30.4	30.3	28.2	27.4	26.2	25.4	21.9
624.0	32.1	31.8	31.6	30.9	33.4	31.7	31.4	30.6	30.6	30.4	28.4	27.4	26.3	25.6	22.0
684.0	32.2	32.0	31.9	31.2	33.4	31.8	31.5	30.8	30.7	30.6	28.7	27.4	26.4	25.8	22.0
744.0	32.3	32.0	31.9	31.1	33.5	31.9	31.7	30.9	30.7	30.5	28.7	27.6	26.5	26.1	22.0
804.1	32.4	32.1	32.1	31.2	33.6	32.1	31.8	31.0	30.8	30.5	28.7	27.8	26.6	25.9	22.0
864.1	32.3	32.4	32.1	31.3	33.6	32.1	31.8	31.1	30.8	30.9	28.9	27.7	26.9	25.9	22.0
924.1	32.5	32.3	32.2	31.7	33.7	32.1	32.0	31.2	31.1	31.0	29.0	27.7	26.8	26.0	22.1
984.2	32.5	32.4	32.3	32.0	33.8	32.3	32.0	31.2	30.8	31.1	28.8	27.6	26.8	25.9	22.2
1044.2	32.6	32.5	32.3	32.3	33.9	32.3	32.1	31.4	30.9	31.0	29.1	27.8	27.0	25.8	22.1
1104.2	32.6	32.6	32.3	32.4	34.0	32.5	32.1	31.4	30.8	31.1	29.1	27.9	27.0	25.9	22.0
1164.3	32.8	32.7	32.3	32.4	34.1	32.7	32.4	31.8	34.5	31.7	29.3	27.9	27.2	26.3	22.2
1224.3	33.3	33.3	33.2	33.2	33.8	33.4	33.6	33.0	32.2	32.9	30.0	28.8	27.3	27.0	22.1
1284.3	34.1	33.9	34.0	34.2	34.2	34.7	34.7	34.2	33.1	33.8	30.7	29.8	27.2	28.0	22.4
1344.4	35.0	35.0	34.9	35.3	34.8	35.9	35.9	35.0	33.7	34.9	31.6	30.7	27.8	28.6	22.2
1404.4	36.0	35.9	36.0	36.1	35.6	37.0	37.2	36.3	34.4	35.6	32.0	31.2	28.1	29.2	22.4
1427.7	36.4	36.5	36.4	36.7	35.6	37.4	37.6	36.6	34.6	36.0	32.3	31.7	28.2	29.5	22.2
1487.7	37.4	37.5	37.4	37.6	36.7	38.5	38.4	37.5	35.0	36.6	32.7	32.3	28.4	30.4	22.4
1547.8	38.4	38.5	38.5	38.9	37.5	39.5	39.5	38.3	36.0	37.5	33.4	33.1	29.0	31.0	22.4
1570.8	38.6	38.9	38.6	39.0	37.4	39.7	39.7	38.5	36.0	37.7	33.8	33.0	29.1	31.2	22.2
1630.8	39.7	39.8	39.9	40.0	38.1	40.7	40.9	39.5	36.8	38.4	34.1	34.0	29.5	32.0	22.5
1653.7	40.2	40.3	40.0	40.1	38.1	41.2	41.1	39.7	37.3	38.8	34.3	34.2	29.6	31.9	22.4
1713.7	40.8	41.0	40.8	40.9	38.7	41.9	41.8	40.2	37.5	39.1	34.9	34.5	29.8	32.5	22.4
1773.8	41.7	41.9	41.4	41.8	39.8	42.7	42.7	40.9	37.9	39.7	35.2	35.1	30.3	33.1	22.4
1833.8	42.3	42.7	42.2	42.4	39.8	43.4	43.5	41.6	38.8	40.5	35.7	35.6	30.6	33.7	22.5
1893.8	43.2	43.4	43.1	43.0	40.3	44.2	44.2	42.4	39.3	41.1	36.1	36.0	31.2	34.1	22.5
1953.9	44.0	44.1	43.9	43.8	41.2	44.8	44.7	42.9	39.6	41.6	36.6	36.5	31.3	34.9	22.5
2013.9	44.6	44.8	44.3	44.6	41.8	45.3	45.3	43.6	40.0	42.0	37.0	36.6	31.6	35.1	22.6
2073.9	45.2	45.4	44.9	45.0	42.1	46.0	46.0	43.8	41.0	42.4	37.4	36.9	32.0	35.6	22.7
2134.0	45.7	45.9	45.7	45.5	42.7	46.6	46.4	44.6	41.2	42.9	37.7	37.4	32.3	36.1	22.5
2194.0	46.3	46.5	46.2	46.1	43.3	47.0	47.1	44.9	41.8	43.4	38.1	37.6	32.6	36.7	22.3
2254.0	46.8	47.2	46.5	46.4	44.0	47.6	47.5	45.4	42.1	43.9	38.6	37.5	32.9	37.2	22.7

2314.1	47.3	47.7	47.0	47.2	45.3	48.1	48.0	45.7	43.6	44.2	39.0	35.4	33.1	38.6	22.8
2374.1	47.8	47.9	47.5	47.5	45.6	48.7	48.5	46.2	44.0	44.7	39.1	35.7	33.5	38.8	22.7
2434.1	48.0	48.3	47.9	47.9	46.2	49.0	48.7	46.8	43.7	44.9	39.7	36.0	33.6	39.3	22.7
2494.2	48.6	48.7	48.3	48.2	46.2	49.5	49.4	47.0	44.7	45.3	39.7	36.3	34.0	39.3	22.8
2554.2	49.0	49.2	48.8	48.6	46.7	49.7	49.5	47.4	44.7	45.6	40.2	36.5	34.2	39.8	22.8
2614.2	49.3	49.6	49.0	48.9	46.7	49.9	50.1	47.7	45.3	46.0	40.3	36.9	34.5	39.8	22.9
2674.3	49.7	50.0	49.6	49.6	47.5	50.4	50.4	48.0	45.4	46.4	41.1	37.2	34.9	40.1	22.9
2734.3	50.2	50.5	49.8	50.1	47.8	50.9	50.7	48.1	46.0	46.6	41.1	37.6	34.8	40.6	23.0
2794.3	50.4	50.8	49.9	49.9	48.4	51.2	51.0	48.2	45.6	46.8	41.3	37.7	35.1	41.0	23.1
2854.4	50.9	51.0	50.4	50.2	48.5	51.5	51.3	48.6	46.4	47.3	41.6	38.1	35.5	40.9	23.2
2914.4	51.0	51.3	50.7	50.6	48.9	51.8	51.6	49.1	46.2	47.5	41.9	38.2	35.7	41.4	23.3
2974.4	51.3	51.6	50.8	50.6	48.6	51.9	51.6	48.8	46.5	47.7	41.7	38.4	35.7	41.3	23.3
3034.5	51.5	51.8	51.1	51.1	49.5	52.2	52.1	49.4	46.7	47.9	42.2	38.5	35.9	41.8	23.5
3094.5	51.8	51.9	51.2	51.4	49.6	52.5	52.3	49.4	47.0	48.1	42.5	38.8	36.3	41.5	23.4
3154.5	52.1	52.3	51.7	51.7	49.8	52.6	52.6	49.8	47.4	48.4	42.7	38.9	36.3	42.3	23.5
3214.6	52.4	52.5	51.7	52.0	50.0	52.9	52.8	49.7	47.3	48.3	42.8	39.1	36.5	42.1	23.6
3274.6	52.5	52.7	52.1	52.1	50.9	53.0	53.0	50.4	47.5	48.8	43.0	39.3	36.6	42.1	23.8
3334.6	52.6	53.0	52.6	52.2	52.1	53.2	53.0	50.4	47.0	48.8	42.9	39.5	36.7	42.1	23.8
3394.7	52.9	53.2	52.4	52.7	53.1	53.5	53.3	50.4	46.4	49.2	43.4	39.6	37.1	41.5	23.8
3454.7	53.2	53.5	52.6	52.7	53.8	53.6	53.4	50.6	46.3	49.3	43.6	40.0	37.1	41.6	24.0
3514.7	53.1	53.6	52.7	52.8	54.0	53.8	53.8	50.7	46.7	49.4	43.7	40.1	37.2	41.8	24.1
3574.8	53.4	53.6	53.0	52.8	53.6	53.9	53.8	51.1	47.1	49.6	43.8	40.1	37.3	41.8	24.1
3634.8	53.3	53.8	53.0	52.9	53.1	53.9	53.7	50.9	47.5	49.6	43.7	40.2	37.3	42.4	24.0
3694.8	53.5	53.9	53.1	53.0	53.6	54.3	54.1	51.4	47.6	49.9	43.7	40.4	37.6	42.6	24.1
3754.9	53.8	54.1	53.2	53.4	55.0	54.3	54.2	51.2	46.7	49.8	43.9	40.3	37.7	41.8	24.1
3814.9	53.8	54.3	53.2	53.2	54.3	54.4	54.4	51.6	47.1	50.0	44.0	40.8	37.9	42.7	24.3
3874.9	54.0	54.3	53.5	53.8	54.5	54.6	54.6	51.1	47.6	50.2	44.4	40.8	38.1	42.5	24.3
3935.0	54.2	54.4	53.7	53.8	54.5	54.9	54.7	51.9	47.4	50.5	44.6	40.8	38.1	43.0	24.5
3995.0	54.2	54.6	53.8	53.8	53.8	54.8	54.8	51.9	48.7	50.7	44.8	40.8	38.3	43.1	24.6
4055.0	54.4	54.7	53.6	53.8	53.6	55.0	54.8	51.8	48.4	50.4	44.6	41.1	38.1	43.3	24.4
4115.1	54.4	54.7	53.9	53.7	54.4	55.0	54.8	51.7	48.2	50.7	44.6	41.3	38.4	43.3	24.6
4175.1	54.5	54.9	53.7	53.9	55.0	55.0	55.0	52.4	48.2	50.7	44.8	41.4	38.4	43.2	24.7
4235.1	54.7	54.7	54.2	53.9	55.5	55.2	55.1	52.4	47.9	50.9	44.6	41.4	38.4	43.0	25.9
4295.2	55.0	55.1	54.2	54.2	55.8	55.4	55.3	52.0	48.3	50.9	45.0	41.6	38.8	43.3	23.8

Grooved Plate Dryout Experiment Data Sheet Date: 10 Sep 92 Time: 1605 Run Designation: G2E2				
Runtime (min)	**Amps**	**Volts**	**Comments**	**Dryout Length**
0			Flowmeter at 15. Remember flowrate should be ±1 drop	
7.4			C7.4 minutes=W7min 48sec; 24sec	off
8.4	2.182	25.5	Turned on power: at 15: 8 sec to do 10 drops at: 026 gm/sec	
23.1	2.177	25.5	Voltage check $T_1=40$	
33.9	2.467	28.93	Changed voltage up	
36.9				
37.9			Unplugged groove	
48.3	2.465	28.92		
50.3			Groove dried out	14"
55.3				14.6"
62.1				15.5"
67.1				
70.1			$T_8=59$ $T_7=57$	15.0"
74.1			Note: ethanol~1mm above plate in reservoir	40cm
78.1	1.721	20.22	Dropped voltage	43cm
W88.			Dryout front moving	37.2cm
89.1			Note change to cm	
			You can see a film in front of a well defined dryout front extending 1-3 cm ahead	
95.8			$T_8=51^0$ where front is at	34cm
99.9	1.729	20.24	emptied flask	
?105				32cm

Grooved Plate Dryout Experiment Data Sheet

Date: 10 Sep 92 Time: 1605 Run Designation: G2E2

Runtime (min)	Amps	Volts	Comments	Dryout Length
111.9			Seems like plate is at steady state but front is moving	
114.3				30cm
119.5				30.00
130.3	1.731	20.25		29.7
129.9				
132.1			These fronts are stable. I can dryout with Q-tip and they return to same location.	30.2
136.9			Front still at 28.2cm	
w137.8			Power down to zero	
w141.5				30cm
w143.8 ?				28cm
w145.6				26cm
147.0				24
147.6				22
148.4				20
149.1				18.0
150.4				16.0
152.3				14.0
155.0				12.0
157.1				8.0
158.9				6.0
161.2				4.0
162.9				2.0
163.7			Groove fully rewet $T_1 = 32^{0}C$	0

Grooved Plate Dryout Experiment Data Sheet Date: 10 Sep 92 Time: 1605 Run Designation: G2E2				
Runtime (min)	Amps	Volts	Comments	Dryout Length
168	1.738	20.30	Power back on	
179.1			Dryout is spread along groove: gradual thinning: puddle at end of groove	
181.1			End of tube dried out	
183.4			See a front at 12 cm. Can see small bubbles in area of front	12cm
192.1			Well defined front $T_2=42$	18.6cm
200.1			not so well defined front $T_6=43$	22.0
202.1	1.733	20.29		
217	1.734	20.29	$T_1=46$	25.cm
219.1				26.5cm
224				
226.1			Emptied flask	
233.1	1.734	20.28		26.8cm
w237.8			Steady state -- shutdown	26.8
242.5				24.0cm
?244.5				22.0
247.0				20.0
248.1				18cm
249.5				16cm
251.6				14cm
253.1				12cm

Grooved Plate Dryout Experiment Data Sheet Date: 10 Sep 92 Time: 1605 Run Designation: G2E2				
Runtime (min)	Amps	Volts	Comments	Dryout Length
254.4				10cm
256.0				8cm
257.5				6cm
259.4			$T_2=32C$	4cm
260.9				2cm
262.1			Note I see brown bead of residue so something in flow $T_1=32$	0cm
			The area of about 8mm at forward moving front seems discolored - even after attempts to clean it.	
262.5			Shutdown Mdot 2.396×10^{-2} Checked after shutdown	

RUN LETTER DESIGNATION: G2E2

DATE: 09-10-1992 TIME: 16:08:16

GROOVE NUMBER: 2

THE RELATIVE HUMIDITY IS 28.99 MM OF MERCURY

THE FLOWMETER SETTING IS : 15

THE PLATE ANGLE IS 0 TIME IN MIN SCALE IN GRAMS

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	SCALE
1.0	22.0	21.7	21.8	22.1	21.8	21.8	21.8	21.9	21.2	20.9	21.2	21.0	20.9	21.3	20.9	21.3	30.755
1.4	22.1	21.6	22.1	22.0	21.7	21.8	21.9	22.0	21.1	21.0	21.0	20.9	20.9	21.2	21.0	21.3	31.504
2.4	22.2	21.8	21.9	22.0	21.7	21.8	21.8	21.9	21.1	20.9	20.9	20.9	20.9	21.2	20.9	21.5	33.524
3.4	22.2	21.7	22.0	22.0	21.7	21.8	21.9	22.1	21.1	20.9	21.1	20.8	20.7	21.2	20.9	21.4	35.418
4.4	22.1	21.6	21.9	22.0	21.8	21.9	21.8	22.0	21.0	20.8	21.0	20.8	21.0	21.2	20.9	21.5	37.232
5.4	22.2	21.7	21.9	22.0	21.7	22.0	21.8	21.9	21.0	20.8	21.1	21.0	21.0	21.2	20.7	21.2	39.044
6.4	22.2	21.6	21.9	22.0	21.8	21.8	21.9	22.0	21.1	20.9	20.9	20.9	21.0	21.3	20.8	21.4	40.803
7.4	22.3	21.6	22.0	22.0	21.8	21.7	21.7	21.9	21.2	20.9	21.1	21.0	20.9	21.3	20.7	21.4	42.521
8.4	22.3	21.6	22.0	22.0	21.8	21.9	21.8	21.9	21.0	20.7	21.2	20.8	20.9	21.2	20.7	21.2	44.231
9.4	22.4	22.0	22.9	22.2	21.8	22.0	21.9	22.1	21.4	21.2	21.2	21.0	21.0	21.2	20.6	21.3	45.934
10.4	23.2	22.9	23.4	23.3	22.9	23.2	23.1	23.6	22.9	22.8	22.3	21.3	20.9	21.2	20.6	21.2	47.643
11.4	24.1	24.3	24.5	24.6	24.5	24.6	24.7	25.4	24.4	24.1	23.2	21.7	21.2	21.3	20.7	21.2	49.328
12.4	25.5	25.5	25.9	26.2	26.2	26.4	26.4	27.1	26.1	25.5	24.0	22.3	21.6	21.5	20.7	21.5	50.997
12.8	26.1	26.2	26.4	26.9	26.8	26.9	26.9	27.7	26.4	25.9	24.4	22.8	21.8	21.6	20.8	21.3	51.671
13.8	27.5	27.6	27.5	28.3	28.3	28.7	28.6	29.2	27.9	27.1	25.3	23.2	22.1	21.8	20.7	21.5	53.333
14.2	27.8	28.2	28.4	28.9	28.9	29.2	29.1	29.9	28.4	27.6	25.6	23.5	22.2	22.0	20.8	21.4	53.980
15.2	29.2	29.7	29.9	30.5	30.4	30.9	30.5	31.3	29.6	28.8	26.5	24.2	22.8	22.4	20.9	21.1	55.654
15.6	29.5	30.1	29.9	30.7	30.9	31.2	30.9	31.7	29.9	29.1	27.0	24.6	23.0	22.4	20.7	21.4	56.300
16.6	30.9	31.4	30.8	32.1	32.4	32.7	32.4	32.9	31.2	30.0	27.7	25.2	23.7	22.9	20.8	21.1	57.970
16.9	31.4	31.9	32.0	32.6	32.9	33.1	32.8	33.4	31.4	30.2	27.9	25.3	23.8	22.9	20.7	21.1	58.634
17.9	32.4	33.4	32.8	33.9	34.1	34.3	34.0	34.7	32.6	31.2	28.7	25.8	24.1	23.2	20.6	21.3	60.324
18.3	33.1	33.9	34.2	34.4	34.5	35.0	34.5	35.2	32.9	31.6	29.1	26.3	24.5	23.5	20.8	21.4	60.976
19.3	34.3	35.1	34.9	35.8	35.8	36.2	35.5	36.3	34.0	32.4	29.9	26.7	24.9	23.8	20.8	21.1	62.652
19.7	34.9	35.6	36.2	36.2	36.5	36.8	36.3	36.7	34.4	33.0	30.5	27.2	25.0	23.9	20.6	21.4	63.335
20.7	35.6	36.8	36.2	37.2	37.6	37.8	37.3	37.7	35.4	33.8	30.7	27.5	25.7	24.2	20.6	21.1	65.068
21.7	36.7	37.9	38.5	38.3	38.6	38.7	38.0	38.6	36.1	34.5	31.5	28.2	26.1	24.7	20.7	21.1	66.804
22.1	37.3	38.5	38.1	38.7	39.1	39.2	38.5	39.1	36.4	35.0	31.9	28.5	26.4	25.0	20.8	21.5	67.481
23.1	38.3	39.6	38.7	39.8	40.0	40.2	39.6	40.0	37.4	35.7	32.6	29.1	27.1	25.4	20.7	[illegible]	69.194
24.1	39.2	40.4	39.6	40.9	40.9	41.1	40.1	41.0	38.0	36.5	33.3	29.6	27.4	25.8	20.8	21.5	70.941
25.1	39.7	41.1	40.1	41.4	41.7	41.9	41.1	41.6	39.0	37.1	33.9	30.1	27.6	26.1	20.8	21.4	72.700
26.1	40.8	42.0	40.7	42.1	42.4	42.7	41.7	42.2	39.4	37.7	34.4	30.5	28.4	26.5	20.8	21.4	74.415
26.5	41.1	42.6	42.0	42.7	43.0	43.2	42.2	42.7	39.9	37.9	34.6	30.9	28.5	26.6	20.7	21.7	75.087
27.5	41.7	43.2	43.5	43.4	43.8	44.0	42.9	43.4	40.5	38.7	35.2	31.2	29.0	26.9	21.0	21.4	76.838
28.5	42.7	44.0	42.7	44.0	44.3	44.5	43.2	44.0	41.0	39.2	35.7	31.8	29.1	27.2	20.9	21.4	78.621
29.5	42.9	44.7	44.0	44.7	45.0	45.1	43.9	44.6	41.5	39.6	36.0	32.1	29.6	27.5	20.8	21.2	80.354
30.5	43.9	45.2	43.6	45.3	45.5	45.7	44.7	45.2	42.0	39.7	36.5	32.7	30.2	28.0	21.0	21.3	82.120
30.9	44.1	45.6	44.7	45.5	45.8	46.0	44.6	45.2	42.2	40.2	36.5	32.6	30.2	28.0	20.7	21.5	82.781
31.9	44.1	46.0	44.4	45.9	46.5	46.8	45.4	46.0	42.9	40.9	37.1	33.1	30.4	28.2	20.9	21.5	84.473
32.9	45.0	46.8	45.6	46.8	47.2	47.3	46.1	46.8	43.4	41.7	37.7	33.5	30.8	28.6	20.8	21.5	86.129
33.9	45.3	47.1	46.1	47.4	47.7	47.8	46.7	47.2	44.0	42.0	38.2	33.9	31.4	29.1	21.0	21.3	87.733
34.9	46.2	47.8	46.4	47.7	48.0	48.4	46.7	47.7	44.3	42.3	38.4	34.3	31.8	29.1	20.8	21.2	89.332
35.9	46.7	48.6	46.8	48.3	48.6	48.8	47.5	48.4	44.7	42.8	38.9	34.5	31.8	29.6	20.9	21.3	90.913
36.9	47.2	49.2	46.9	49.3	49.3	49.5	48.1	49.2	46.2	44.1	39.8	35.2	32.0	29.8	21.0	21.5	92.479

37.9	48.1	49.9	49.5	50.1	50.5	50.6	48.9	49.8	46.6	44.4	40.3	35.5	32.6	30.0	21.0	21.6	94.789
38.9	48.9	50.9	49.4	50.4	50.9	51.2	50.2	50.8	47.7	45.9	41.2	36.3	33.1	30.6	21.2	21.5	97.205
39.9	49.6	51.7	50.2	51.8	52.4	52.5	51.4	52.0	48.4	46.4	41.7	36.6	33.6	30.8	21.2	21.4	99.477
40.9	50.3	52.5	50.6	52.9	53.2	53.4	51.8	52.8	48.9	47.1	42.5	37.4	33.8	31.1	21.2	21.8	101.619
41.9	51.3	53.4	51.1	53.7	54.1	54.0	52.6	53.4	49.8	47.6	42.8	37.5	34.3	31.5	21.1	21.7	103.615
42.3	51.0	53.6	51.8	53.8	54.3	54.6	53.2	53.4	50.3	47.6	43.0	37.8	34.4	31.7	21.2	21.6	104.400
43.3	51.5	54.2	53.2	54.3	55.2	55.1	53.2	54.1	50.6	48.7	43.8	38.4	35.0	31.9	21.1	21.5	106.348
44.3	52.4	54.9	52.4	55.3	55.5	56.0	54.5	55.1	50.9	48.8	44.0	38.8	35.4	32.2	21.2	21.6	108.266
45.3	53.2	55.6	53.2	55.8	56.6	56.5	55.0	55.7	51.4	49.5	44.6	39.3	35.7	32.6	21.4	21.7	110.115
46.3	53.5	55.9	54.2	55.9	56.4	56.7	55.1	56.1	52.1	49.8	44.9	39.6	36.0	32.6	21.2	21.8	111.960
47.3	54.5	56.7	55.1	56.9	57.2	57.3	56.0	56.3	52.5	50.0	45.1	39.7	36.1	33.0	21.5	21.7	113.788
48.3	54.6	57.2	54.1	56.6	57.5	57.6	56.1	56.9	53.1	50.6	45.7	40.2	36.6	33.3	21.3	21.7	115.587
49.3	55.3	54.9	55.8	57.5	58.3	55.4	57.0	53.4	52.6	51.3	45.9	40.4	36.7	33.8	21.5	22.0	117.342
50.3	55.6	57.4	55.9	57.6	58.4	58.2	56.9	54.8	53.6	51.3	46.2	40.8	37.3	33.9	21.5	21.9	119.131
51.3	55.8	58.5	55.1	58.3	58.9	59.0	57.7	57.7	53.9	51.8	47.0	41.3	37.5	34.2	21.5	21.9	120.932
52.3	56.1	58.8	56.8	58.4	59.2	59.6	58.0	58.4	54.4	52.3	47.3	41.6	38.0	34.3	21.5	21.7	122.684
53.3	56.2	59.1	56.5	59.0	59.5	59.8	58.0	59.1	54.5	52.5	47.7	41.9	37.9	34.8	21.6	21.8	124.471
54.3	57.2	59.9	56.5	60.1	60.8	60.9	59.1	59.6	55.2	52.9	47.7	42.0	38.3	34.9	21.7	21.9	126.248
55.3	57.5	60.4	58.7	60.1	60.5	60.8	58.8	59.8	55.6	53.3	48.1	42.4	38.4	35.2	21.7	21.8	127.960
56.3	57.1	60.5	58.9	59.5	60.2	60.9	59.7	60.4	55.9	53.2	48.5	42.7	39.0	35.4	22.0	21.9	129.685
57.3	58.3	61.1	58.7	60.8	61.3	61.6	59.9	60.8	56.1	53.8	48.9	43.0	39.2	35.6	21.9	21.7	131.409
57.7	58.5	61.4	57.9	61.0	61.6	62.0	60.0	60.9	56.3	54.4	49.0	43.1	39.4	35.7	21.9	21.8	132.080
58.7	58.7	61.6	59.6	61.0	61.6	61.8	60.3	61.3	56.5	54.1	49.1	43.5	39.5	35.8	22.2	22.0	133.763
59.7	58.5	61.7	59.2	61.6	62.0	62.6	60.7	61.7	56.8	54.8	49.7	43.7	39.8	36.2	22.0	21.8	135.479
60.7	59.8	62.3	59.2	62.1	62.7	62.8	61.1	61.4	57.4	54.8	49.5	43.7	40.0	36.2	22.2	21.9	137.193
61.1	59.2	62.3	60.4	62.3	62.9	62.9	60.9	62.2	57.0	55.3	49.9	43.9	40.1	36.5	22.1	21.9	137.853
62.1	59.8	62.6	60.9	62.1	62.6	62.6	60.6	62.0	57.4	54.7	49.5	43.8	40.0	36.4	22.3	22.0	139.505
63.1	59.8	62.6	59.9	62.1	62.9	63.0	60.9	62.0	57.6	55.5	50.2	44.0	40.2	36.6	22.1	22.0	141.151
64.1	60.6	62.8	60.2	62.8	63.4	63.3	61.4	62.6	57.7	55.5	50.2	44.1	40.2	36.6	22.2	22.0	142.801
65.1	60.4	63.4	61.1	63.1	63.8	63.8	61.9	62.7	57.9	55.7	50.6	44.4	40.7	37.1	22.3	22.1	144.438
66.1	60.6	63.8	60.3	63.3	63.9	64.0	62.0	63.0	58.4	55.8	50.5	44.7	40.7	37.0	22.4	22.0	146.087
67.1	61.1	64.1	62.7	63.2	63.8	64.1	62.1	63.2	58.5	55.6	50.8	45.0	41.0	37.3	22.6	22.2	147.820
68.1	60.4	63.8	62.2	63.3	64.1	64.2	62.8	63.5	58.4	56.5	51.0	45.2	41.1	37.3	22.5	22.0	149.967
69.1	61.4	64.5	62.1	63.6	64.0	64.3	62.6	63.5	59.0	56.5	51.2	45.1	41.5	37.6	22.5	22.0	151.979
70.1	61.0	64.3	60.9	64.3	64.8	64.6	63.2	63.7	59.3	57.1	51.6	45.5	41.4	37.6	22.6	22.1	153.862
71.1	61.4	64.7	62.7	64.1	64.9	64.9	63.3	64.0	59.2	56.9	51.8	45.3	41.5	37.9	22.7	22.1	155.666
72.1	61.3	64.7	62.7	64.6	65.2	65.0	63.3	64.2	59.5	57.0	51.9	45.8	41.9	38.2	22.7	22.1	157.409
73.1	61.6	65.0	63.1	64.5	65.2	65.3	63.2	64.5	59.7	57.3	51.8	45.8	41.8	38.3	22.9	22.2	159.115
74.1	62.2	65.3	63.1	64.6	65.3	65.4	64.0	64.2	59.7	57.0	51.9	45.9	42.1	38.5	22.8	22.2	160.789
75.1	61.7	65.2	62.6	64.5	65.4	65.4	63.8	64.6	59.6	57.8	52.2	46.3	42.3	38.5	22.8	22.1	162.404
76.1	62.1	65.6	61.9	65.0	65.6	65.7	64.0	64.9	60.2	57.8	52.4	46.1	42.3	38.5	23.1	22.2	164.006
77.1	62.1	65.5	63.0	64.9	65.6	65.5	63.8	64.9	60.3	57.9	52.4	46.3	42.6	38.7	23.1	22.2	165.621
78.1	62.7	66.0	62.5	65.0	66.1	66.1	64.1	65.0	60.5	57.6	52.4	46.3	42.6	38.8	23.1	22.2	167.176
79.1	62.2	65.5	62.7	65.1	65.8	66.0	63.8	65.2	60.2	58.0	52.6	46.7	42.9	38.8	23.0	22.0	168.733
80.1	61.9	65.3	63.2	64.5	65.3	65.5	63.5	64.7	60.4	57.3	51.7	46.5	42.4	38.5	23.4	22.3	170.266
81.1	62.4	65.2	62.6	65.2	65.7	65.5	63.8	64.6	59.0	57.3	51.9	46.1	42.6	38.9	23.3	22.3	171.781
82.1	61.7	64.4	61.9	63.8	64.2	64.3	62.4	63.3	58.5	55.9	51.2	46.0	42.6	38.8	23.4	22.5	173.296
83.1	60.9	64.1	61.3	63.7	64.4	64.2	62.1	62.7	57.9	55.4	50.8	45.9	42.3	38.8	23.4	22.1	174.822
84.1	60.5	63.2	60.6	62.2	62.8	63.0	61.2	61.4	57.4	55.2	50.7	45.6	42.3	39.0	23.3	22.1	176.333
85.1	59.7	62.2	58.9	61.4	61.7	62.1	60.2	60.8	56.3	54.2	50.3	45.7	42.2	38.8	23.7	22.1	177.827

86.1	58.9	61.7	58.7	60.9	61.4	61.7	59.8	60.4	55.3	54.0	49.9	45.0	41.8	38.6	23.4	22.2	179.321
87.1	58.3	60.8	57.9	60.0	60.5	60.8	58.9	59.3	55.3	53.5	49.3	45.0	41.7	38.9	23.6	22.1	180.795
88.1	57.5	60.4	58.1	59.5	59.7	59.8	58.2	58.8	54.6	52.5	48.6	44.6	41.5	38.4	23.6	22.3	182.269
89.1	56.8	59.6	56.6	59.0	59.3	59.4	57.4	58.1	53.8	52.1	48.3	44.1	41.2	38.3	23.8	22.1	183.798
90.1	56.6	58.9	55.8	57.9	58.3	58.6	56.4	57.4	53.8	51.4	48.0	43.8	41.2	38.2	23.8	22.0	185.841
91.1	55.5	57.9	55.5	57.0	57.5	57.7	56.2	56.8	53.0	51.4	47.7	43.5	40.9	38.2	23.9	22.1	187.703
91.5	55.8	57.9	55.0	56.8	57.6	57.7	56.1	56.7	52.9	51.2	47.5	43.5	40.9	38.0	23.7	22.1	188.440
92.5	55.4	57.4	54.7	57.2	57.4	57.4	55.7	56.2	52.5	50.6	47.4	43.3	40.8	38.1	24.0	22.1	190.177
93.5	54.3	56.6	55.3	56.2	56.5	56.8	55.5	55.7	51.9	50.4	46.9	43.1	40.3	37.7	23.9	22.3	191.850
93.9	54.2	56.8	54.4	55.8	56.3	56.7	55.1	55.6	51.5	50.3	47.0	42.8	40.2	37.8	24.4	22.1	192.514
94.9	53.7	56.2	53.8	55.8	56.0	56.1	54.5	55.3	51.3	50.0	46.8	42.7	40.1	37.7	24.0	22.3	194.112
95.9	53.6	55.8	53.0	55.2	55.6	55.7	54.4	54.9	51.0	49.6	46.2	42.5	40.1	37.5	24.2	22.2	195.744
96.9	53.0	55.2	52.1	54.7	55.1	55.4	53.9	54.4	50.6	49.4	46.2	42.4	39.7	37.4	24.2	22.0	197.342
97.9	52.7	54.6	52.6	54.4	54.6	54.7	53.4	53.9	50.6	49.0	45.7	42.0	39.8	37.2	24.1	22.2	198.888
98.9	52.8	54.6	52.2	54.0	54.2	54.5	52.7	53.6	50.4	48.5	45.6	41.8	39.5	37.3	24.5	22.2	200.428
99.9	52.2	54.1	52.1	53.5	54.0	54.2	52.4	53.2	50.2	48.4	45.4	41.9	39.4	37.1	24.3	22.1	201.973
100.9	52.0	54.0	52.5	53.4	53.7	54.0	52.2	52.9	49.6	48.4	45.2	41.6	39.0	37.0	24.3	22.1-	1.062
101.9	51.6	53.8	51.9	52.9	53.3	53.8	52.4	52.7	49.5	48.2	45.0	41.3	39.1	36.9	24.4	22.1	2.565
102.9	51.3	53.0	51.6	52.7	52.9	53.6	51.7	52.5	49.2	47.7	44.7	41.0	38.8	36.6	24.3	22.1	4.068
103.9	50.4	52.6	51.4	52.2	52.5	52.8	51.1	51.8	48.8	47.1	44.2	40.6	38.7	36.3	24.5	22.4	5.560
104.9	50.9	52.8	50.9	52.4	52.5	52.9	51.6	52.1	48.5	47.6	44.4	41.0	38.6	36.2	24.7	22.4	7.062
105.9	50.1	52.4	50.4	51.9	52.2	52.6	50.9	51.6	48.5	47.2	44.1	40.6	38.4	36.1	24.6	22.2	8.554
106.9	50.4	52.2	51.4	51.6	52.2	52.2	50.7	51.3	48.3	46.7	43.7	40.3	38.1	36.1	24.6	22.3	10.058
107.9	50.2	51.8	50.2	51.5	51.8	51.8	50.6	51.2	48.0	46.7	43.8	40.1	38.1	36.1	24.5	22.2	11.518
108.9	49.9	51.9	50.2	51.4	51.4	51.7	50.2	51.1	48.0	46.7	43.7	40.2	38.0	35.9	24.7	22.5	13.016
109.9	49.9	51.7	50.3	50.9	51.1	51.7	50.0	50.8	47.6	46.1	43.2	40.0	38.0	35.9	24.6	22.4	14.479
110.9	49.4	51.4	50.2	51.0	51.1	51.4	50.0	50.7	47.6	45.9	43.2	39.8	37.8	35.8	24.9	22.5	15.930
111.9	49.4	51.2	49.7	51.0	51.1	51.2	49.7	50.5	47.4	46.1	43.1	39.8	37.8	35.7	24.7	22.5	17.424
112.9	49.4	51.2	49.4	51.1	51.1	51.1	50.1	50.6	47.3	46.2	43.1	39.6	37.6	35.6	24.7	22.5	18.913
113.9	49.3	51.0	49.6	50.5	50.8	51.1	49.7	50.4	47.3	45.8	42.8	39.5	37.6	35.4	24.8	22.5	20.391
114.9	49.0	50.9	49.0	50.2	50.5	50.9	49.5	50.0	47.2	45.9	43.0	39.7	37.6	35.3	24.6	22.2	21.876
115.9	48.4	50.7	48.7	50.1	50.4	50.8	49.5	50.0	47.1	45.8	42.7	39.5	37.4	35.5	24.8	22.2	23.373
116.9	48.5	50.4	49.0	50.1	50.5	50.7	48.9	49.8	46.9	45.2	42.8	39.5	37.4	35.3	24.9	22.2	24.865
117.9	48.6	50.4	48.8	49.9	50.0	50.3	48.5	49.6	46.9	45.3	42.4	39.1	37.0	35.3	24.9	22.3	26.321
118.9	48.3	50.1	48.7	49.8	50.2	50.3	48.5	49.4	46.6	44.9	42.1	39.0	37.2	35.2	24.8	22.4	27.828
119.9	48.6	50.1	48.3	50.0	50.4	50.5	49.2	49.5	46.6	45.2	42.4	38.9	36.9	34.9	24.9	22.4	29.332
120.9	48.3	49.8	48.5	49.4	49.8	50.1	48.5	49.2	46.3	45.0	42.1	39.0	36.9	35.1	24.9	22.2	30.804
121.9	48.1	49.8	48.4	49.4	49.9	50.1	48.6	49.2	46.3	45.0	42.4	39.0	36.9	34.9	24.9	22.4	32.298
122.9	48.1	50.0	48.4	49.4	49.5	49.8	48.5	49.0	46.2	44.9	42.1	38.7	36.9	34.8	24.8	22.4	33.803
123.9	48.0	49.8	48.3	49.4	49.7	49.9	48.5	49.1	46.3	44.9	42.1	38.9	36.9	34.9	24.9	22.2	35.283
124.9	47.8	49.5	47.5	49.1	49.4	49.7	48.3	49.0	46.3	44.7	42.1	38.7	36.7	35.0	24.8	22.2	36.757
125.9	47.9	49.5	47.2	49.1	49.4	49.7	48.3	48.8	45.9	44.9	42.4	38.8	36.8	35.0	24.9	22.2	38.272
126.9	47.8	49.3	48.3	49.4	49.4	49.8	48.1	48.8	45.8	44.5	42.0	38.6	36.8	34.8	24.9	22.2	39.756
127.9	47.5	49.3	47.6	49.1	49.1	49.6	48.2	48.7	46.0	44.5	41.8	38.6	36.6	34.8	25.0	22.2	41.058
128.9	47.5	49.2	47.5	48.9	49.3	49.2	47.8	48.5	45.4	44.7	41.8	38.6	36.9	34.8	24.8	22.3	42.455
129.9	47.5	49.4	47.3	49.0	49.3	49.6	48.5	48.9	45.7	44.6	41.8	38.7	36.7	34.7	25.2	22.3	44.401
130.9	47.4	49.4	47.7	49.2	49.5	49.7	48.6	48.7	45.7	44.7	41.7	38.6	36.5	34.6	25.2	22.4	46.187
131.9	47.5	49.1	48.4	48.8	49.0	49.2	47.8	48.5	45.6	44.3	41.5	38.4	36.4	34.5	25.0	22.2	47.949
132.9	47.1	49.0	47.8	48.7	48.7	49.2	48.1	48.5	45.5	42.9	41.6	38.4	36.4	34.4	24.9	22.2	49.625
133.9	47.5	48.8	48.0	48.6	48.8	49.0	47.9	48.5	45.5	43.9	41.6	38.3	36.3	34.5	25.0	22.3	51.226

134.9	47.4	49.1	46.5	48.1	48.8	49.3	48.3	48.1	45.8	44.2	41.3	38.2	36.3	34.5	25.1	22.2	52.816
135.9	47.1	48.7	47.3	48.6	48.8	48.8	47.6	48.3	45.5	44.0	41.3	37.8	36.2	34.2	25.0	22.2	54.377
136.9	47.1	48.8	46.6	48.4	48.7	49.2	47.9	48.5	45.4	44.0	41.3	38.2	36.2	34.5	25.2	22.5	55.909
137.9	47.5	48.8	47.3	48.8	49.1	49.2	47.9	48.3	45.3	44.2	41.3	38.1	36.2	34.3	25.2	22.3	57.371
138.9	46.6	48.3	46.6	47.9	48.0	48.6	47.2	47.6	44.6	43.2	41.1	38.1	36.1	34.2	25.1	22.3	58.882
139.9	46.1	47.7	46.1	47.0	47.2	47.6	46.0	46.5	43.6	42.1	40.3	37.8	35.9	34.3	25.4	22.4	60.354
140.9	45.1	46.7	45.3	46.2	46.3	46.5	45.1	45.4	42.4	41.2	39.5	37.2	35.7	34.2	25.2	22.6	61.797
141.9	44.5	45.8	44.5	45.3	45.2	45.2	43.6	44.1	41.5	40.2	38.4	36.6	35.5	33.9	25.2	22.6	63.261
142.9	43.8	44.8	43.5	44.1	44.2	44.3.	42.8	43.3	40.9	39.8	38.2	36.4	35.1	33.8	25.2	22.3	64.711
143.9	42.5	43.5	42.4	43.1	43.1	43.3	41.8	42.1	39.6	38.6	37.2	35.5	34.5	33.4	25.1	22.6	66.150
144.3	42.7	43.6	42.1	43.0	42.7	42.6	41.3	41.8	39.5	38.6	37.3	35.5	34.6	33.4	25.0	22.6	66.738
145.3	41.7	42.5	41.3	41.9	41.9	41.8	40.7	41.1	38.7	37.9	36.9	35.2	34.3	33.1	25.2	22.5	68.139
145.7	41.4	42.2	40.7	41.8	41.9	41.5	40.4	40.7	38.6	37.6	36.6	35.1	34.1	33.1	25.2	22.6	68.719
146.7	40.7	41.5	40.0	40.8	40.7	40.7	39.4	39.8	37.7	37.0	36.0	34.7	33.9	32.8	25.3	22.4	70.148
147.7	39.5	40.5	39.4	40.0	39.9	39.9	38.7	39.2	37.4	36.6	35.6	34.4	33.7	32.7	25.1	22.4	71.577
148.1	39.4	40.2	39.0	39.9	39.8	39.5	38.7	39.2	37.1	36.3	35.7	34.1	33.5	32.5	25.1	22.3	72.126
149.1	38.8	39.5	38.5	39.1	39.1	39.0	38.1	38.3	36.5	35.9	35.1	34.0	33.2	32.4	25.2	22.3	73.541
150.1	38.3	39.0	37.7	38.6	38.6	38.4	37.6	37.8	36.0	35.4	34.6	33.6	32.8	32.0	25.5	22.6	74.943
151.1	37.6	38.3	37.3	37.7	37.7	37.7	36.9	37.1	35.5	35.0	34.1	33.1	32.5	31.8	25.2	22.4	76.364
152.1	37.0	37.6	36.7	37.3	37.1	37.2	36.2	36.7	35.0	34.2	33.8	32.8	32.5	31.7	25.2	22.3	77.753
153.1	36.5	37.0	36.1	36.7	36.5	36.4	35.8	36.3	34.7	34.0	33.3	32.3	31.9	31.5	25.3	22.5	79.170
154.1	36.0	36.3	35.7	36.1	35.9	35.9	35.2	35.6	33.9	33.5	32.8	32.1	31.6	31.1	25.3	22.4	80.584
155.1	35.4	35.9	35.1	35.6	35.4	35.5	34.7	34.9	33.6	33.0	32.7	31.7	31.5	31.0	25.2	22.2	81.996
156.1	34.8	35.3	34.6	35.1	34.8	34.8	34.3	34.7	33.1	32.9	32.2	31.4	31.2	30.8	25.1	22.7	83.414
157.1	34.5	34.9	34.1	34.8	34.4	34.4	33.7	34.1	32.8	32.4	32.0	31.2	31.1	30.5	25.0	22.5	85.186
158.1	34.0	34.3	33.6	34.1	34.2	34.1	33.5	33.8	32.4	32.0	31.6	31.0	30.8	30.4	25.2	22.4	86.963
159.1	33.6	33.9	33.2	33.7	33.5	33.6	32.9	33.5	32.0	31.6	31.4	30.6	30.4	30.1	25.3	22.6	88.621
160.1	33.2	33.4	32.9	33.4	33.2	33.0	32.6	32.9	31.8	31.4	30.9	30.4	30.3	30.0	25.2	22.6	90.262
161.1	33.0	33.0	32.5	32.9	32.6	32.8	32.3	32.6	31.3	30.9	30.6	30.3	29.9	29.8	25.2	22.4	91.908
162.1	32.6	32.6	31.9	32.4	32.2	32.2	31.7	32.0	31.0	30.5	30.5	29.9	29.9	29.5	25.1	22.5	93.485
163.1	32.2	32.2	31.8	32.1	31.9	32.0	31.4	31.7	30.7	30.5	30.3	29.5	29.5	29.2	25.2	22.5	95.075
164.1	31.8	32.0	31.4	31.7	31.5	31.7	31.1	31.4	30.4	30.0	29.7	29.5	29.3	29.2	25.2	22.4	96.641
165.1	31.3	31.4	31.1	31.4	31.2	31.2	30.8	31.2	30.1	29.9	29.7	29.3	29.1	28.9	25.2	22.4	98.177
166.1	31.2	31.4	30.9	31.2	31.1	31.0	30.7	31.0	29.9	29.7	29.5	29.2	28.8	28.9	25.2	22.5	99.719
167.1	30.7	31.0	30.4	30.9	30.7	30.6	30.4	30.8	29.7	29.4	29.0	28.8	28.7	28.5	25.0	22.3	101.291
168.1	30.6	30.6	30.3	30.5	30.4	30.5	30.0	30.4	29.4	29.1	29.1	28.7	28.5	28.4	25.2	22.4	102.847
169.1	30.8	30.9	31.1	31.0	30.7	30.7	30.6	31.0	30.1	29.8	29.3	28.6	28.5	28.4	25.4	22.5	104.387
170.1	31.0	31.4	30.9	31.5	31.3	31.3	31.0	31.8	30.8	30.6	29.8	28.9	28.4	28.1	25.3	22.5	105.944
171.1	31.9	32.0	31.8	32.2	32.2	32.3	32.0	32.7	31.8	31.3	30.2	28.8	28.3	28.1	25.2	22.4	107.517
172.1	32.4	32.7	32.2	32.9	32.9	33.1	32.7	33.4	32.3	31.7	30.7	29.2	28.7	28.2	25.1	22.5	109.023
173.1	32.7	33.2	32.4	33.6	33.7	33.9	33.6	34.0	32.8	32.2	31.0	29.3	28.5	28.0	25.2	22.4	110.564
174.1	33.3	33.9	33.7	34.2	34.3	34.4	34.1	34.8	33.3	32.7	31.2	29.5	28.6	28.2	25.1	22.4	112.124
175.1	34.2	34.7	34.1	35.1	35.1	35.2	34.7	35.5	33.8	33.0	31.7	29.6	28.7	28.1	25.1	22.4	113.644
176.1	34.7	35.2	35.4	35.4	35.4	35.9	35.2	36.0	34.4	33.4	32.0	29.8	28.9	28.3	25.1	22.6	115.155
177.1	35.3	36.1	35.6	36.2	36.4	36.5	35.9	36.5	35.0	33.8	32.1	30.2	29.0	28.3	24.9	22.4	116.680
178.1	35.9	36.7	36.1	36.9	37.0	37.1	36.5	37.1	35.4	34.4	32.7	30.6	29.3	28.5	25.1	22.7	118.196
179.1	36.5	37.3	36.6	37.5	37.7	37.8	37.0	37.6	35.8	34.7	32.9	30.6	29.5	28.6	24.9	22.5	119.731
180.1	36.7	37.7	37.0	37.9	38.0	38.2	37.4	38.0	36.2	35.2	33.0	30.9	29.8	28.7	24.8	22.4	121.280
181.1	37.3	38.2	37.6	38.4	38.6	38.7	37.9	38.6	36.4	35.7	33.8	31.2	30.0	28.9	24.8	22.2	123.191
182.1	37.9	38.7	37.7	38.8	38.9	39.0	38.5	38.9	36.9	35.9	33.8	31.4	30.0	29.1	24.9	22.5	125.500

183.1	38.3	39.1	38.2	39.0	39.5	39.4	38.5	39.3	37.4	36.3	34.4	31.7	30.3	29.2	24.7	22.3	127.605
184.1	38.5	39.6	38.7	39.8	39.7	40.1	39.1	39.6	37.7	36.5	34.4	31.8	30.3	29.4	25.1	22.3	129.538
185.1	38.6	39.6	37.8	39.7	39.9	40.4	39.3	40.1	38.0	36.8	34.6	32.2	30.6	29.5	24.9	22.3	131.360
186.1	39.2	40.2	39.5	40.3	40.5	40.7	39.6	40.3	38.3	37.1	34.8	32.4	30.7	29.7	24.8	22.3	133.111
187.1	39.7	40.7	40.0	40.9	41.1	41.2	40.2	40.7	38.5	37.5	35.1	32.5	30.8	29.7	24.8	22.2	134.817
188.1	40.0	41.1	40.6	41.3	41.4	41.6	40.8	41.3	38.7	37.8	35.6	32.7	31.4	30.0	24.8	22.4	136.484
189.1	40.3	41.3	40.7	41.4	41.7	41.7	40.6	41.3	39.2	37.6	35.5	32.8	31.2	30.0	24.8	22.1	138.124
190.1	40.7	41.9	40.7	41.8	41.9	42.1	41.2	41.7	39.3	38.3	35.8	33.2	31.5	30.1	24.9	22.6	139.745
191.1	40.8	42.1	40.7	42.0	42.0	42.2	41.1	41.9	39.5	38.3	36.0	33.4	31.5	30.3	24.9	22.5	141.302
192.1	40.9	42.2	41.9	42.1	42.3	42.4	41.4	41.9	39.7	38.5	36.0	33.4	31.7	30.1	24.9	22.6	142.883
193.1	41.4	42.7	41.5	42.5	42.6	42.9	41.8	42.4	40.0	38.4	36.1	33.5	32.1	30.4	24.7	22.3	144.440
194.1	41.5	42.8	41.9	42.7	42.8	43.1	42.1	42.6	40.3	38.9	36.6	33.9	32.0	30.7	24.7	22.2	146.001
195.1	41.5	42.9	41.7	43.1	43.1	43.2	42.2	42.8	40.3	38.9	36.6	33.8	32.1	30.6	24.8	22.4	147.529
196.1	42.0	43.3	42.1	43.1	43.3	43.4	42.2	43.0	40.8	39.4	36.8	34.0	32.5	30.7	24.8	22.4	149.088
197.1	42.2	43.7	42.6	43.3	43.4	43.7	42.3	43.1	40.8	39.4	37.2	34.2	32.4	30.9	24.8	22.4	150.626
198.1	42.5	43.8	42.6	43.6	43.8	43.8	42.8	43.5	41.1	39.6	37.2	34.3	32.6	30.9	24.7	22.3	152.149
199.1	42.7	43.9	43.4	43.7	43.8	43.9	43.0	43.5	41.1	39.8	37.4	34.5	32.7	31.0	24.9	22.4	153.692
200.1	42.6	44.1	43.7	44.0	44.2	44.0	42.9	43.7	41.1	39.5	37.4	34.3	32.6	31.1	24.6	22.4	155.244
201.1	42.9	44.0	43.0	44.0	44.3	44.2	43.0	43.8	41.5	39.9	37.4	34.5	32.7	31.1	24.7	22.3	156.768
202.1	43.2	44.4	43.0	44.2	44.4	44.6	43.4	44.0	41.6	40.2	37.9	34.7	32.7	31.2	24.8	22.2	158.456
203.1	43.0	44.4	42.8	44.5	44.7	44.7	43.9	44.2	41.5	40.4	37.8	34.9	32.9	31.3	24.7	22.4	160.630
204.1	43.5	44.7	42.7	44.6	44.6	44.8	43.8	44.4	41.8	40.4	37.9	34.7	33.0	31.4	24.5	22.4	162.640
205.1	43.6	44.9	44.1	44.7	45.0	45.2	44.0	44.5	42.1	40.6	37.9	35.0	33.1	31.4	24.7	22.2	164.506
206.1	43.6	44.9	43.7	44.9	45.0	45.2	44.1	44.6	42.0	40.6	38.2	35.0	33.3	31.7	24.7	22.3	166.311
207.1	43.9	45.2	44.3	45.1	45.1	45.3	44.3	44.8	42.5	41.0	38.3	35.3	33.6	31.8	24.6	22.3	168.066
208.1	43.9	45.3	44.8	45.1	45.4	45.6	44.3	44.9	42.6	41.0	38.5	35.5	33.5	31.8	24.7	22.2	169.756
209.1	44.1	45.5	44.1	45.4	45.4	45.5	44.1	44.9	42.4	41.1	38.5	35.4	33.6	31.7	24.5	22.4	171.429
210.1	44.2	45.6	45.0	45.6	45.7	45.8	44.5	45.3	42.7	41.4	38.7	35.6	33.7	31.9	24.6	22.5	173.096
211.1	44.5	45.8	44.5	45.7	45.7	45.9	44.8	45.3	43.0	41.4	38.8	35.8	33.7	32.0	24.9	22.4	174.738
212.1	44.2	45.8	43.6	45.7	46.0	46.1	44.8	45.4	42.5	41.4	38.8	35.6	33.6	32.1	24.6	22.5	176.336
213.1	43.9	45.8	44.5	45.7	46.0	45.8	44.7	45.5	42.8	41.6	38.7	35.6	33.9	32.1	24.7	22.5	177.950
214.1	44.2	45.7	44.7	45.6	45.9	46.0	44.7	45.5	42.9	41.3	38.5	35.6	33.8	32.0	24.7	22.4	179.521
215.1	44.5	45.9	45.0	45.7	45.9	46.0	45.1	45.5	43.0	41.6	38.8	35.7	34.0	32.3	24.6	22.2	181.121
216.1	44.4	46.1	45.2	46.0	46.0	46.1	45.0	45.6	43.1	41.7	39.3	36.0	33.9	32.2	24.7	22.5	182.714
217.1	44.7	46.1	44.7	46.2	46.1	46.1	45.1	45.9	43.0	41.7	39.1	36.2	34.3	32.6	24.6	22.5	184.283
218.1	44.8	46.4	45.5	46.1	46.4	46.2	45.4	45.8	42.9	41.8	39.1	36.2	34.1	32.3	24.9	22.6	185.968
219.1	45.1	46.3	45.9	46.3	46.3	46.3	45.3	45.8	43.2	41.9	39.1	36.0	34.1	32.6	24.6	22.4	188.661
220.1	44.9	46.4	45.2	46.2	46.3	46.5	45.2	46.0	43.4	42.0	39.4	36.2	34.3	32.5	24.8	22.4	191.010
221.1	44.6	46.4	45.9	46.3	46.5	46.5	45.3	45.9	43.5	42.1	39.4	36.4	34.2	32.6	24.6	22.5	193.118
222.1	45.0	46.5	45.7	46.3	46.5	46.8	45.8	45.9	43.7	42.1	39.4	36.3	34.2	32.5	24.6	22.4	195.016
223.1	45.1	46.6	45.0	46.4	46.4	46.6	45.7	46.0	43.0	42.0	39.5	36.1	34.2	32.4	24.5	22.6	196.858
224.1	45.0	46.7	45.3	46.7	46.4	46.5	45.4	46.0	43.4	42.2	39.3	36.4	34.1	32.5	24.6	22.3	198.613
225.1	45.1	46.6	45.4	46.4	46.4	46.5	45.1	45.9	43.2	41.8	39.4	36.1	34.1	32.5	24.6	22.3	200.293
226.1	45.3	47.0	46.2	46.5	46.8	46.7	45.6	46.3	43.7	42.2	39.5	36.3	34.4	32.6	24.6	22.4	2.213
227.1	45.1	46.7	45.1	46.4	46.6	46.6	45.5	46.2	43.4	42.0	39.6	36.3	34.4	32.5	24.7	22.3	3.839
228.1	45.5	46.8	44.6	46.7	46.9	46.8	45.4	46.0	43.5	42.0	39.5	36.4	34.4	32.6	24.7	22.2	5.409
229.1	45.4	46.8	45.9	46.8	47.1	47.0	46.0	46.3	43.8	42.3	39.4	36.5	34.5	32.6	24.8	22.6	7.010
230.1	45.6	47.2	44.8	47.0	47.0	46.9	46.0	46.3	43.6	42.5	39.7	36.4	34.6	32.6	24.5	22.3	8.576
231.1	45.3	46.9	44.6	46.7	47.0	47.0	46.0	46.3	43.8	42.3	39.5	36.3	34.4	32.7	24.8	22.3	10.149
232.1	45.4	46.9	46.2	46.6	47.0	47.1	45.8	46.5	44.0	42.2	39.8	36.7	34.5	32.9	24.8	22.2	11.683

233.1	45.4	47.1	45.9	46.8	47.1	47.1	46.1	46.5	43.7	42.4	39.6	36.7	34.8	32.7	24.7	22.4	13.236
234.1	45.2	47.0	45.3	46.8	47.1	47.0	45.8	46.4	43.7	42.3	39.7	36.7	34.7	32.9	24.7	22.3	14.796
235.1	45.7	47.3	45.2	47.0	47.1	47.1	45.8	46.5	43.8	42.4	39.8	36.5	34.6	32.9	24.9	22.3	16.333
236.1	45.4	46.8	45.5	46.6	46.9	47.1	45.8	46.5	44.0	42.4	39.8	36.6	34.6	32.9	24.9	22.4	17.869
237.1	45.7	47.4	45.7	46.8	47.0	47.1	45.9	46.7	44.0	42.4	39.9	36.7	34.6	33.0	24.7	22.6	19.422
238.1	45.5	47.0	45.3	47.0	47.2	47.1	46.4	46.7	43.7	42.4	39.9	36.7	34.8	32.9	24.6	22.2	20.943
239.1	45.1	46.4	45.3	46.3	46.5	46.5	45.3	45.8	42.8	41.4	38.9	36.3	34.8	32.8	24.8	22.4	22.459
240.1	44.5	45.8	44.5	45.5	45.4	45.6	44.3	44.6	42.0	40.6	38.7	36.4	34.5	32.9	25.0	22.3	23.988
241.1	43.6	44.9	43.5	44.5	44.5	44.5	43.2	43.7	41.3	39.6	38.2	35.9	34.4	32.8	24.7	22.2	25.538
242.1	43.1	44.1	42.6	43.3	43.4	43.5	42.1	42.6	40.1	38.5	37.2	35.6	34.2	32.7	24.9	22.5	27.283
243.1	42.1	43.0	41.5	42.3	42.3	42.2	41.1	41.5	39.2	38.3	36.9	35.2	33.9	32.5	24.7	22.5	29.147
244.1	40.9	42.2	40.7	41.6	41.6	41.6	40.5	40.8	38.4	37.5	36.4	34.6	33.6	32.2	24.8	22.5	30.920
244.5	40.7	41.8	40.7	41.3	41.3	41.4	39.9	40.3	38.2	37.2	36.1	34.6	33.7	32.3	24.7	22.3	31.589
245.5	40.1	40.9	39.8	40.4	40.1	40.1	39.0	39.4	37.4	36.3	35.5	34.2	33.4	32.1	24.8	22.5	33.229
246.5	39.2	40.0	38.7	39.6	39.6	39.3	38.5	39.0	36.9	36.1	35.0	33.6	33.0	31.9	25.0	22.4	34.853
247.5	38.5	39.4	37.9	39.0	38.8	38.8	37.9	38.3	36.2	35.5	35.0	33.4	32.6	31.7	24.7	22.1	36.462
248.5	37.9	38.7	37.5	38.2	37.8	38.0	37.2	37.5	35.7	35.0	34.2	33.1	32.3	31.5	24.9	22.4	38.022
249.5	37.2	37.8	36.6	37.5	37.6	37.5	36.5	36.9	35.1	34.4	33.8	32.7	32.0	31.3	24.8	22.2	39.585
250.5	36.8	37.3	36.3	36.7	36.7	36.7	35.8	36.4	34.8	34.2	33.6	32.3	31.7	31.1	25.0	22.4	41.147
251.5	36.0	36.5	35.6	36.1	36.1	36.1	35.5	36.0	34.1	33.7	33.1	32.2	31.4	30.9	24.9	22.5	42.659
252.5	35.6	35.9	35.2	35.6	35.4	35.3	34.8	35.1	33.7	33.1	32.5	31.8	31.3	30.6	24.9	22.3	44.182
253.5	34.9	35.3	34.5	34.9	34.9	35.0	34.2	34.8	33.4	32.7	32.3	31.3	31.1	30.5	24.9	22.6	45.713
254.5	34.4	34.9	34.1	34.5	34.4	34.5	33.7	34.2	33.0	32.3	32.0	31.1	30.7	30.1	24.7	22.3	47.210
255.5	34.1	34.4	33.6	34.2	34.1	34.2	33.7	33.7	32.4	32.0	31.6	31.0	30.4	30.1	25.2	22.3	48.734
256.5	33.5	33.8	33.0	33.5	33.4	33.4	32.9	33.5	32.2	31.5	31.3	30.6	30.1	29.9	24.9	22.4	50.263
257.5	33.1	33.4	32.8	33.3	33.0	33.1	32.5	32.9	31.8	31.1	30.9	30.3	30.2	29.8	25.0	22.3	51.797
258.5	32.8	33.0	32.4	32.8	32.6	32.6	32.0	32.5	31.4	30.9	30.8	29.9	29.9	29.5	24.7	22.4	53.310
259.5	32.4	32.6	32.1	32.3	32.2	32.4	31.6	32.4	31.0	30.7	30.4	29.8	29.6	29.4	25.0	22.4	54.850
260.5	31.9	32.0	31.6	32.0	31.9	32.0	31.4	31.9	30.7	30.3	30.3	29.5	29.3	29.1	24.7	22.4	56.402
261.5	31.5	31.7	31.3	31.6	31.4	31.6	31.2	31.5	30.3	30.0	29.8	29.3	29.1	29.0	24.9	22.2	57.909
262.5	31.3	31.5	30.9	31.3	31.2	31.2	30.8	31.3	30.2	29.7	29.6	29.2	29.1	28.6	25.0	22.5	59.483

Grooved Plate Dryout Experiment Data Sheet Date: 18 Sep 92 Time: 1448 Run Designation: G2E3				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			Didn't plug groove and there's puddle near dam. Note: computer time is 23-24 sec behind watch	
C9.4	0.871	10.12	Turned on power go for $Q_{c,max}$	
C23.4	0.875	10.16	Power check -- 8.739 watts T_l=26 C	
C33.4	1.125	13.12	Increased Voltage -- 14.76 watts	
C43.4	1.124	13.10	Tried to dry up puddle -- no good; puddle at 4" in front of dam	
C51.4	1.324	15.46	Upped power to 20.47 W T_l=30 C	
C68.4	1.554	18.15	Upped power to 28.19 W T_l=34 C	
C94.4	1.553	18.16	Swabbed out end of groove; front wouldn't rewet; front rewet to ⇒	13 cm
C96.4			Front moved to⇒ T_l=40 C	14.0
C99.4			Front stabilized	13.1
W102			Shut down power	12.8
W103.1				12.0
W107.4				10.0
W109.8				8.0
W111.7				5.4
W112.6				3.5
W113.4				2.0
W114.5			rewet	0

Grooved Plate Dryout Experiment Data Sheet Date: 18 Sep 92 Time: 1448 Run Designation: G2E3				
Runtime (min)	Amps	Volts	Comments	Dryout Length
C114.5			Shutdown Δt=29 sec Definitely alcohol residue at front	

RUN LETTER DESIGNATION: G2E3

DATE: 09-18-1992 TIME: 14:52:56

GROOVE NUMBER: 2

THE BAROMETRIC PRESSURE IS 28.778 MM OF MERCURY

THE FLOWMETER SETTING IS : 15

THE PLATE ANGLE IS 0

TIME IN MIN; SCALE IN GRAMS

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	SCALE
1.0	22.6	21.9	21.5	22.2	21.9	21.8	21.8	22.0	21.3	21.0	21.2	21.3	21.4	21.6	21.2	22.0	47.648
1.4	22.5	22.0	21.8	22.2	21.8	21.8	21.7.	22.1	21.5	21.0	21.2	21.2	21.2	21.7	21.3	21.8	48.279
2.4	22.4	22.0	21.7	22.1	21.8	21.9	21.5	21.8	21.5	21.1	21.2	21.5	21.3	21.7	21.2	21.7	49.960
3.4	22.5	21.9	21.6	22.1	21.7	21.7	21.6	21.9	21.4	21.1	21.3	21.3	21.1	21.5	21.1	21.7	51.617
4.4	22.4	22.0	21.5	21.9	21.8	21.7	21.7	21.8	21.4	21.0	21.1	21.3	21.4	21.7	21.1	21.9	53.255
5.4	22.5	21.8	21.8	22.1	21.8	21.7	21.7	22.0	21.4	21.1	21.2	21.2	21.2	21.5	21.2	22.0	54.856
6.4	22.4	21.8	21.7	22.1	21.8	21.8	21.6	21.8	21.5	21.1	21.1	21.1	21.1	21.5	21.3	21.8	56.485
7.4	22.5	21.9	21.6	22.0	21.8	21.8	21.8	21.9	21.5	21.2	21.3	21.3	21.2	21.7	21.2	21.8	58.115
8.4	22.6	22.1	21.7	22.2	21.9	21.8	21.8	21.9	21.5	21.1	21.3	21.4	21.3	21.5	21.3	21.8	59.713
9.4	22.4	21.9	21.6	21.9	21.6	21.7	21.7	21.8	21.3	20.9	21.1	21.3	21.2	21.4	21.1	21.8	61.329
10.4	22.5	21.8	21.8	22.1	21.8	21.8	21.6	21.9	21.4	21.4	21.3	21.4	21.1	21.4	21.2	21.7	62.929
11.4	22.5	22.0	21.9	22.3	21.9	21.9	21.9	22.2	21.7	21.4	21.6	21.2	21.0	21.4	20.9	21.8	64.554
12.4	22.9	22.3	21.9	22.6	22.3	22.3	22.3	22.5	21.9	21.6	21.5	21.3	21.2	21.3	21.2	21.8	66.159
13.4	23.1	22.5	22.6	22.9	22.6	22.7	22.6	22.7	22.1	21.8	21.6	21.3	21.2	21.6	21.5	21.9	67.805
14.4	23.1	22.7	23.0	23.0	22.8	22.7	22.7	23.1	22.4	21.8	21.9	21.3	21.1	21.4	21.0	21.8	69.423
15.4	23.5	23.1	22.5	23.4	23.2	23.1	23.0	23.3	22.5	22.1	22.0	21.8	21.3	21.4	21.2	21.9	71.045
16.4	23.6	23.2	23.1	23.5	23.2	23.5	23.2	23.4	22.7	22.1	22.0	21.6	21.4	21.5	21.1	21.8	72.657
17.4	23.9	23.5	23.3	23.8	23.5	23.5	23.5	23.6	22.8	22.5	22.3	21.8	21.4	21.3	21.0	21.8	74.275
18.4	24.1	23.7	23.8	24.1	23.8	24.0	23.9	24.0	23.3	22.7	22.2	21.8	21.4	21.6	21.2	21.8	75.854
19.4	24.2	23.9	23.9	24.2	24.0	24.0	23.8	24.1	23.2	22.8	22.3	21.9	21.6	21.6	20.9	21.7	77.515
20.4	24.5	24.3	24.2	24.4	24.3	24.3	24.2	24.4	23.4	23.2	22.8	22.2	21.6	21.6	21.1	21.8	79.157
21.4	24.5	24.2	24.3	24.6	24.4	24.4	24.3	24.4	23.6	23.1	22.6	22.1	21.8	21.6	21.1	21.7	80.773
22.4	25.0	24.6	24.9	24.9	24.8	24.8	24.4	24.8	23.7	23.1	23.1	22.5	21.8	21.7	21.2	21.9	82.423
23.4	24.9	24.7	24.2	25.1	24.8	24.9	24.5	24.8	23.9	23.3	22.9	22.4	21.9	21.7	21.0	21.7	84.046
24.4	25.2	24.8	25.1	25.1	24.9	24.9	24.7	24.9	23.8	23.4	23.0	22.4	22.0	22.0	21.0	21.7	85.685
25.4	25.2	25.1	24.8	25.2	25.2	25.2	25.0	25.1	24.2	23.6	23.0	22.4	21.9	22.1	21.1	21.7	87.251
26.4	25.4	25.2	24.9	25.5	25.3	25.4	25.2	25.4	24.3	23.9	23.3	22.7	22.1	22.0	21.2	21.8	88.874
27.4	25.6	25.4	25.2	25.6	25.5	25.5	25.3	25.4	24.4	23.8	23.5	22.7	22.3	22.2	21.0	21.9	90.435
28.4	25.7	25.4	24.7	25.6	25.5	25.4	25.4	25.5	24.3	23.5	23.2	22.7	22.2	22.1	21.3	21.9	91.972
29.4	25.8	25.6	25.3	25.8	25.8	25.8	25.6	25.7	24.5	24.0	23.5	22.8	22.4	22.3	21.1	21.5	93.508
30.4	26.0	25.7	25.5	26.1	25.8	25.9	25.8	25.8	24.8	24.2	23.8	23.0	22.6	22.4	21.2	21.8	95.055
31.4	26.0	25.8	25.5	26.1	25.8	26.1	25.8	25.9	24.7	24.1	23.5	22.9	22.5	22.3	20.9	21.7	96.580
32.4	26.2	26.0	25.5	26.3	26.1	26.2	25.9	26.1	24.9	24.2	23.8	23.1	22.4	22.4	21.1	21.8	98.122
33.4	26.3	26.2	26.1	26.4	26.1	26.1	26.0	26.2	25.0	24.5	23.9	23.1	22.7	22.5	21.1	21.8	99.671
34.4	26.5	26.3	26.1	26.5	26.4	26.4	26.1	26.3	25.2	24.7	24.0	23.2	23.0	22.7	21.0	21.8	101.231
35.4	26.6	26.4	26.3	26.7	26.5	26.5	26.4	26.5	25.4	25.0	24.2	23.3	22.7	22.5	21.0	21.8	102.789
36.4	26.9	26.6	26.4	26.9	26.8	26.9	26.5	26.8	25.7	25.1	24.2	23.4	22.8	22.5	21.2	21.8	104.383
37.4	27.1	26.9	27.4	27.2	27.1	27.2	26.8	27.1	26.0	25.3	24.4	23.6	23.0	22.7	20.9	21.8	105.954
38.4	27.2	27.3	26.9	27.6	27.4	27.4	27.3	27.6	26.1	25.3	24.6	23.7	23.0	22.7	21.2	22.0	107.531
39.4	27.5	27.4	27.2	27.8	27.5	27.6	27.4	27.7	26.4	25.7	24.8	23.8	23.1	22.7	20.9	21.7	109.146
40.4	27.7	27.7	27.2	28.0	27.8	28.0	27.7	27.9	26.8	25.8	24.9	23.8	23.1	22.8	21.2	21.8	110.715
41.4	28.1	28.1	27.7	28.3	28.2	28.2	28.0	28.2	26.9	26.1	25.3	24.0	23.3	22.7	21.1	21.8	112.319
42.4	28.2	28.3	28.2	28.6	28.3	28.4	28.2	28.3	27.1	26.2	25.3	24.3	23.6	23.0	21.1	21.6	113.919

43.4	28.4	28.4	28.0	28.6	28.6	28.6	28.3	28.5	27.1	26.4	25.7	24.4	23.5	23.0	21.0	21.6	115.527
44.4	28.5	28.7	28.2	28.9	28.7	28.7	28.4	28.6	27.3	26.5	25.6	24.6	23.6	23.0	21.0	21.8	117.151
45.4	28.8	28.9	28.7	29.1	29.0	29.2	28.8	28.9	27.5	26.7	25.7	24.8	23.9	23.2	21.1	21.8	118.728
46.4	29.0	29.1	28.7	29.5	29.2	29.3	29.0	29.0	27.6	26.8	25.9	24.6	23.9	23.3	21.2	21.6	120.304
47.4	29.2	29.2	29.1	29.5	29.3	29.4	29.1	29.2	27.7	26.9	26.2	25.0	23.7	23.2	21.0	21.6	121.860
48.4	29.4	29.4	29.0	29.5	29.5	29.5	29.2	29.4	27.9	27.1	26.2	24.9	24.1	23.3	21.1	21.8	123.364
49.4	29.5	29.5	29.9	29.8	29.6	29.8	29.4	29.5	28.1	27.3	26.1	25.0	24.1	23.4	21.2	22.0	124.958
50.4	29.5	29.6	29.8	29.8	29.8	29.8	29.5	29.7	28.2	27.2	26.2	25.0	24.1	23.6	21.3	21.8	126.519
51.4	29.8	29.8	29.6	30.1	29.8	30.0	29.6	29.9	28.3	27.7	26.5	25.1	24.2	23.7	21.2	22.0	128.064
52.4	29.9	29.9	29.9	30.3	30.1	30.2	29.8	30.0	28.6	27.7	26.6	25.2	24.4	23.7	21.2	21.8	129.646
53.4	30.1	30.3	30.6	30.5	30.3	30.3	30.0	30.3	28.8	28.0	26.9	25.4	24.6	23.6	21.0	21.8	131.255
54.4	30.4	30.6	30.4	31.0	30.7	30.7	30.6	30.6	29.1	28.3	27.0	25.6	24.5	23.9	21.0	21.8	132.853
55.4	30.7	30.9	30.0	31.2	31.0	31.1	30.7	30.9	29.2	28.3	27.1	25.7	24.8	24.0	21.1	21.7	134.434
56.4	30.9	31.1	31.7	31.6	31.3	31.1	31.0	31.1	29.4	28.5	27.4	26.0	24.8	24.0	21.2	21.7	136.062
57.4	31.0	31.4	30.5	31.6	31.5	31.4	31.4	31.5	29.9	28.9	27.4	26.0	24.8	24.0	21.4	21.7	137.669
58.4	31.3	31.6	31.4	31.8	31.8	31.8	31.6	31.7	30.1	29.1	27.6	26.2	25.1	23.9	21.1	21.8	139.248
59.4	31.5	31.8	32.4	32.3	32.1	32.1	31.8	32.0	30.3	29.4	28.0	26.3	25.3	24.3	21.2	21.7	140.867
60.4	31.9	32.1	32.6	32.4	32.4	32.4	32.0	32.1	30.3	29.4	28.3	26.6	25.4	24.4	21.1	21.6	142.482
61.4	32.1	32.3	32.6	32.7	32.6	32.8	32.2	32.4	30.6	29.8	28.3	26.6	25.5	24.5	21.0	21.5	144.112
62.4	32.3	32.6	31.5	32.9	32.7	32.9	32.4	32.6	30.9	29.8	28.5	26.8	25.7	24.7	21.2	21.5	145.788
63.4	32.5	32.9	32.4	32.9	32.9	33.0	32.8	32.9	30.9	30.0	28.7	26.9	25.7	24.8	21.3	21.7	147.486
64.4	32.4	33.0	33.4	33.0	33.3	33.3	32.9	33.0	31.2	30.2	28.9	26.9	25.8	24.7	21.3	21.7	149.195
65.4	32.8	33.2	33.6	33.4	33.3	33.3	32.9	33.1	31.4	30.4	28.9	27.1	25.7	24.8	21.2	21.7	150.885
66.4	32.9	33.2	33.7	33.4	33.5	33.4	33.2	33.3	31.4	30.5	29.0	27.3	26.2	24.8	21.1	21.7	152.604
67.4	33.2	33.6	33.3	33.8	33.6	33.6	33.3	33.4	31.4	30.6	29.0	27.4	26.0	24.8	21.3	21.8	154.300
68.4	33.1	33.6	34.3	33.9	33.9	33.8	33.3	33.6	31.7	30.6	29.1	27.4	25.9	24.8	21.3	22.0	155.962
69.4	33.6	33.9	34.2	34.1	34.0	34.1	33.8	33.8	32.1	31.0	29.2	27.5	26.2	25.1	21.5	21.8	157.660
70.4	33.9	34.2	33.8	34.5	34.4	34.5	34.1	34.2	32.4	31.1	29.6	27.9	26.5	24.9	21.3	21.9	159.352
71.4	34.0	34.4	34.7	34.7	34.6	34.7	34.4	34.6	32.7	31.3	30.2	27.9	26.4	25.2	21.2	21.8	161.015
72.4	34.4	34.9	34.5	35.1	34.9	35.1	34.7	34.9	33.0	31.8	30.3	28.1	26.6	24.8	21.3	21.8	162.637
73.4	35.1	35.2	35.0	35.5	35.4	35.4	35.0	35.2	33.3	32.1	30.3	28.4	27.0	25.1	21.2	21.8	164.239
74.4	34.8	35.5	35.5	36.0	35.9	35.8	35.3	35.5	33.7	32.5	30.5	28.4	27.1	25.3	21.2	21.9	165.815
75.4	35.2	35.9	36.1	35.9	36.0	36.2	35.8	35.8	33.9	32.6	30.8	28.7	27.1	25.4	21.4	22.1	167.342
76.4	35.8	36.2	36.6	36.2	36.4	36.5	36.2	36.2	34.0	32.8	31.0	28.8	27.3	25.4	21.6	21.9	168.901
77.4	35.8	36.6	36.5	36.9	36.9	36.8	36.4	36.7	34.5	33.3	31.2	29.1	27.6	25.8	21.3	21.8	170.460
78.4	36.2	36.8	37.2	36.9	37.1	37.2	36.7	36.9	34.8	33.6	31.4	29.3	27.7	25.6	21.5	21.9	171.988
79.4	36.5	37.1	36.9	37.3	37.2	37.5	36.7	37.1	34.9	33.5	31.6	29.4	27.8	25.8	21.4	21.7	173.548
80.4	36.6	37.4	36.8	37.5	37.5	37.5	37.2	37.3	35.1	33.9	32.1	29.7	27.9	26.0	21.5	21.9	175.131
81.4	36.8	37.7	37.3	37.9	37.9	37.9	37.4	37.6	35.5	34.1	32.1	29.8	28.2	26.0	21.5	21.9	176.673
82.4	37.2	38.0	37.5	38.2	38.1	38.1	37.5	37.8	35.4	34.2	32.4	29.9	28.1	26.1	21.6	22.0	178.250
83.4	37.5	38.2	38.4	38.2	38.2	38.3	37.6	37.9	35.6	34.4	32.3	30.2	28.4	26.5	21.6	21.8	179.817
84.4	37.3	38.2	37.8	38.6	38.7	38.6	38.1	38.3	35.8	34.4	32.4	30.1	28.5	26.0	21.6	21.9	181.407
85.4	37.6	38.5	38.7	38.7	38.7	38.6	38.1	38.3	36.1	34.7	32.7	30.2	28.5	26.5	21.5	21.9	182.983
86.4	37.9	38.6	39.6	38.6	38.8	38.8	38.3	38.3	36.2	34.9	32.8	30.4	28.7	26.3	21.6	21.8	184.555
87.4	38.1	38.9	38.3	38.8	38.7	38.9	38.3	38.6	36.2	34.9	33.1	30.6	28.7	26.5	21.6	21.9	186.140
88.4	38.2	38.9	38.5	39.0	39.0	39.1	38.7	38.8	36.4	35.2	33.1	30.5	28.9	26.8	21.8	21.9	187.704
89.4	38.2	39.2	39.2	39.4	39.3	39.2	38.7	39.0	36.6	35.2	33.3	30.7	29.1	26.5	21.6	22.1	189.305
90.4	38.5	39.3	39.2	39.5	39.7	39.7	39.0	39.3	36.9	35.5	33.5	31.1	29.4	26.8	21.7	22.0	190.908
91.4	38.9	39.6	38.9	39.7	39.7	39.8	39.2	39.3	37.1	35.6	33.5	31.0	29.3	26.9	21.6	22.0	1.231
92.4	38.8	39.8	39.1	39.8	39.8	39.8	39.6	39.3	37.0	35.8	33.5	31.1	29.3	27.0	21.9	22.0	2.820

93.4	38.9	39.8	39.3	40.0	39.8	39.7	39.3	39.6	37.0	35.7	33.7	31.3	29.3	27.1	21.8	21.8	4.440
94.4	39.0	39.8	39.9	39.7	39.9	39.7	39.4	39.7	37.3	35.9	33.7	31.4	29.4	27.1	21.8	21.9	6.010
95.4	39.2	40.1	40.2	40.2	40.0	40.2	39.5	39.8	37.3	36.0	34.0	31.6	29.6	27.1	21.8	22.1	7.605
96.4	39.1	40.3	39.1	40.2	40.2	40.1	39.7	39.8	37.5	36.2	34.0	31.6	29.7	27.1	21.8	22.0	9.242
97.4	39.4	40.3	39.8	40.3	40.2	40.3	39.6	40.0	37.8	36.4	34.3	31.7	29.9	27.5	21.8	22.0	10.868
98.4	39.4	40.3	40.4	40.3	40.4	40.3	39.6	40.0	37.6	36.3	34.1	31.6	29.9	27.3	21.9	22.2	12.430
99.4	39.4	40.3	39.6	40.5	40.2	40.5	39.8	40.1	37.7	36.4	34.3	31.7	30.1	27.9	21.9	22.1	14.039
100.4	39.7	40.7	39.1	40.6	40.5	40.7	40.1	40.3	37.9	36.5	34.4	32.0	29.9	27.7	21.9	22.0	15.668
101.4	40.1	40.7	40.7	40.8	40.6	40.4	39.9	40.3	37.9	36.8	34.5	31.9	30.2	27.8	21.9	22.1	17.269
102.4	39.7	40.6	40.1	40.6	40.7	40.9	40.1	40.4	37.9	36.6	34.5	31.9	30.2	27.8	21.8	21.8	18.893
103.4	39.3	40.2	39.4	40.2	40.2	40.3	39.7	39.6	37.3	35.6	33.9	31.9	30.1	27.9	22.0	21.7	20.508
104.4	38.9	39.8	39.2	39.8	39.5	39.6	39.0	38.8	36.9	35.2	33.5	31.8	30.0	28.0	22.0	21.9	22.078
105.4	38.4	39.2	38.3	39.1	38.8	38.8	38.1	38.0	35.7	34.7	33.2	31.5	30.1	27.9	21.9	22.0	23.682
106.4	37.7	38.2	37.5	38.2	38.1	38.1	37.3	37.4	35.3	34.1	33.0	31.2	30.0	27.7	22.1	22.1	25.288
107.4	37.2	37.6	37.3	37.6	37.3	37.3	36.7	36.6	34.5	33.4	32.4	31.0	29.5	27.8	22.0	22.0	26.885
108.5	36.8	37.1	36.2	37.0	36.6	36.6	36.0	36.0	34.1	33.0	32.1	30.9	29.7	27.7	22.1	21.9	28.440
109.5	36.1	36.4	35.6	36.3	35.9	35.8	35.5	35.3	33.6	32.7	31.7	30.5	29.4	27.7	22.2	22.3	30.029
110.5	35.4	35.8	35.4	35.7	35.4	35.3	34.7	34.9	33.0	32.2	31.4	30.1	29.2	27.4	22.1	21.9	31.607
111.5	34.8	35.2	34.5	34.8	34.7	34.6	34.1	34.1	32.4	31.6	30.9	29.8	28.9	27.0	22.2	22.0	33.135
112.5	34.2	34.7	34.3	34.5	34.2	34.0	33.6	33.7	32.0	31.4	30.5	29.7	29.0	27.2	22.2	21.9	34.693
113.5	33.7	34.0	33.7	33.7	33.6	33.6	33.0	33.2	31.7	31.0	30.3	29.3	28.5	27.0	22.1	22.1	36.234
114.5	33.3	33.5	33.1	33.4	33.2	33.0	32.6	32.8	31.3	30.7	30.3	29.0	28.2	27.0	22.0	22.0	37.764

Grooved Plate Dryout Experiment Data Sheet

Date: 19 Sep 92 Time: 1502 Run Designation: G2E4

Runtime (min)	Amps	Volts	Comments	Dryout Length
C15.4	0 = W15.02 Again looking for $Q_{c,max}$ and others Δt=W-C=23 sec I put toothpick in groove to eliminate puddle and it's working but groove is full Changed SSSUM to subtract 0.5 → now at steady state, it's near zero every time			
C20.4			Filled up tank with flask	
C26.4	1.333	15.54	Turned on power -- unplugged dam	
			After swabbing, front took 35 sec to move 2 cm	
			After swabbing T_l=27 C front took 139 sec to move 2 cm	
C39.4			fully wet grove	
C53.4			Front is back from end of groove!	
			It moved slowly forward after swabbing	
W58.7			Δt=27 sec	9 cm
W63.0	1.325	15.48	front resists movement forward T_l=35 C	6.4
C73.4	1.326	15.52	Note: puddle 10 cm in front of dam	7.7
W78.4			Steady state T_l=36 SSSUM=0.07	7.65
W79.5	1.249	14.57	Dropped power	
C103.5	1.247	14.57		8.6
C108.5			Note: T_l is still 36 C. By swabbing and prodding w/tooth pick. Moved front up to →	7.2
C113.5			Δt=21 sec	6.5
W118.1	1.163	13.55	Dropped down power	6.6

Grooved Plate Dryout Experiment Data Sheet

Date: 19 Sep 92 Time: 1502 Run Designation: G2E4

Runtime (min)	Amps	Volts	Comments	Dryout Length
	One definitely must make efforts to find stable front. T_l down to 35. Note: there is some sort of chemical activity at the front. A discolored fluid usually persists for 1-2 cm from front. I swab it away and a yellow residue is left on cotton ⇛ clear fluid should be used for determinations.			
C135.5	1.162	13.54	T_l=35 Power = 15.733	6.0cm
C139.5			Emptied flask	5.3
C143.5	1.160	13.54	Power = 15.7064	
			whole groove rewet. T_l=35	
C154.5			Note: using scale t=143.5 154.5 'm=7.028 23.659 ⇛ m=0.0252	5.0
C175.5			T_l=34 This is pains takingly slow	
W181.1				3.5
C181.5	1.055	12.3	P=12.977	
C192.5			Groove is rewet! T_l=34	
			I tried to keep it form rewetting but can't	
C193.5	1.057	12.33		
C194.5	1.112	12.98	Δt=25 sec T_l=34 C	
C211.5	1.110	12.96	can't stop it from rewetting the whole groove T_l=34	
W213.9	1.142	13.31	Upped power	
C226.5	1.140	13.30	could go either way. front near groove end T_l=34	
C245.5	1.139	13.30	Can't keep groove wet	1.0
C248.5			Shut down. I need to measure flowrate. So I'm plugging up groove #2	

Grooved Plate Dryout Experiment Data Sheet Date: 19 Sep 92 Time: 1502 Run Designation: G2E4				
Runtime (min)	Amps	Volts	Comments	Dryout Length
C263.5			I've plugged up the groove as best I can. $M_{scale}=189.654$	
C275.6			Emptied flask	
C286.6			18.467 Gms	
C295.6				
			$\Delta t=22$ sec $t=285.6$ $M=16.811$ $t=295.6$ $M=33.267$ $\Delta m/\Delta t$ = 0.0274267	
C298.6			BYE Shut down	

RUN LETTER DESIGNATION: G2E4
DATE: 09-19-1992 TIME: 15:06:50
GROOVE NUMBER: 2
THE BAROMETRIC PRESSURE IS 28.998 MM OF MERCURY
THE FLOWMETER SETTING IS : 15
THE PLATE ANGLE IS 0 TIME IN MIN; SCALE IN GRAMS

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	SCALE
1.0	22.1	21.7	22.0	21.9	21.5	21.3	21.3	21.8	21.1	20.8	21.1	21.2	21.3	20.9	21.0	21.6	90.329
1.4	22.3	21.7	22.0	22.0	21.5	21.4	21.3	21.7	21.1	20.8	21.0	21.1	21.2	21.0	21.0	21.5	91.275
2.4	22.2	21.7	22.0	21.9	21.5	21.4	21.3	21.7	21.1	20.9	21.1	21.0	21.0	20.9	21.1	21.4	93.675
3.4	22.1	21.7	22.0	21.8	21.5	21.3	21.3	21.7	21.3	21.0	21.0	21.0	21.0	20.8	21.0	21.5	95.918
4.4	22.3	21.7	21.7	21.8	21.4	21.2	21.3	21.7	21.1	20.8	21.1	21.1	21.2	20.5	21.0	21.5	98.054
5.4	22.1	21.6	22.0	21.8	21.4	21.3	21.1	21.6	21.1	20.8	20.8	21.0	20.8	20.7	21.0	21.6	100.082
6.4	22.1	21.6	21.9	21.9	21.4	21.3	21.3	21.6	20.9	20.9	21.0	20.9	21.0	20.8	21.0	21.3	102.094
7.4	22.1	21.6	21.7	21.8	21.5	21.4	21.3	21.6	21.0	20.8	21.0	20.9	20.9	20.6	21.1	21.5	104.059
8.4	22.2	21.7	22.0	21.9	21.6	21.4	21.4	21.7	21.0	20.9	21.1	21.1	21.0	20.7	21.1	21.4	105.968
9.4	22.1	21.6	21.8	21.9	21.6	21.5	21.4	21.7	21.2	20.8	21.1	21.1	20.9	20.8	21.1	21.7	107.893
10.4	22.2	21.7	21.8	21.8	21.5	21.4	21.5	21.7	21.1	20.9	21.0	21.0	20.9	20.6	21.0	21.7	109.776
11.4	22.1	21.6	22.0	21.9	21.5	21.4	21.4	21.7	21.1	20.9	20.9	20.9	20.8	20.6	21.0	21.6	111.650
12.4	22.2	21.6	21.9	21.8	21.5	21.5	21.3	21.6	21.1	20.8	21.1	20.9	20.8	20.5	20.9	21.5	113.491
13.4	22.1	21.6	21.8	21.8	21.4	21.4	21.3	21.5	21.0	20.8	21.1	21.1	20.9	20.6	20.8	21.4	115.320
14.4	22.1	21.7	21.9	21.8	21.5	21.2	21.3	21.5	21.0	20.7	20.8	20.8	21.1	20.5	21.0	21.7	117.167
15.4	22.2	21.6	21.8	21.8	21.6	21.4	21.4	21.7	21.0	20.8	21.0	21.0	20.9	20.5	21.1	21.5	118.948
16.4	22.1	21.5	22.0	21.8	21.5	21.4	21.4	21.7	21.0	20.8	21.0	20.9	20.8	20.5	20.9	21.6	120.690
17.4	22.1	21.5	21.8	21.8	21.5	21.5	21.4	21.4	21.1	20.8	21.0	20.9	20.8	20.5	21.0	21.6	122.405
18.4	22.1	21.6	21.8	21.7	21.3	21.4	21.2	21.7	21.0	20.9	20.9	20.8	20.9	20.5	20.9	21.6	124.061
19.4	22.1	21.6	21.8	21.7	21.3	21.5	21.2	21.6	20.9	20.9	21.0	20.9	20.8	20.5	21.1	21.6	125.724
20.4	22.1	21.5	21.8	21.8	21.3	21.5	21.4	21.6	21.0	20.7	21.0	21.1	20.9	20.4	20.8	21.4	127.365
21.4	22.1	21.6	21.8	21.8	21.5	21.4	21.4	21.6	21.0	20.7	21.0	20.8	21.0	20.4	20.8	21.5	1.849
22.4	22.1	21.7	21.7	21.8	21.3	21.4	21.2	21.5	20.9	20.8	20.9	20.9	20.8	20.0	20.9	21.6	3.461
23.4	22.2	21.5	21.9	21.8	21.4	21.3	21.5	21.6	20.9	20.8	21.1	20.9	20.8	20.0	20.8	21.6	5.081
24.4	22.2	21.5	21.8	21.9	21.4	21.4	21.4	21.5	20.9	20.8	21.0	20.9	20.9	20.1	21.0	21.6	6.687
25.4	22.1	21.5	21.8	21.8	21.5	21.6	21.3	21.6	20.9	20.7	21.0	20.8	21.0	20.1	20.7	21.4	8.261
26.4	22.2	21.4	21.8	21.8	21.5	21.5	21.3	21.5	20.9	20.9	20.9	20.9	20.9	20.2	20.8	21.6	9.869
27.4	22.4	22.0	22.1	22.2	21.8	21.7	21.7	22.1	21.6	21.6	21.4	20.9	21.1	20.3	20.8	21.5	11.458
28.4	22.9	22.5	23.2	22.9	22.6	22.7	22.7	23.1	22.3	22.2	22.0	21.2	21.0	20.3	20.8	21.6	13.047
29.4	23.5	23.2	23.6	23.5	23.2	23.3	23.4	23.6	23.0	22.7	22.0	21.4	21.1	20.7	20.7	21.4	14.604
30.4	24.0	23.8	23.7	24.3	24.1	24.1	24.0	24.3	23.6	23.2	22.4	21.8	21.5	20.7	20.9	21.6	16.134
31.4	24.7	24.3	24.2	24.8	24.6	24.6	24.5	24.8	23.9	23.3	22.7	22.0	21.6	20.8	20.8	21.4	17.635
32.4	25.2	24.9	24.8	25.5	25.2	25.4	25.4	25.5	24.6	24.0	23.3	22.3	21.8	21.0	20.7	21.6	19.124
33.4	25.6	25.5	26.7	26.0	25.8	25.8	25.8	25.8	24.9	24.2	23.5	22.6	21.8	21.1	20.7	21.4	20.643
34.4	26.2	26.0	26.2	26.5	26.4	26.5	26.2	26.4	25.6	24.9	23.9	22.8	22.2	21.3	20.7	21.5	22.156
35.4	26.5	26.6	26.8	26.9	26.7	26.9	26.6	26.7	25.8	25.3	24.1	23.0	22.3	21.5	20.8	21.4	23.619
36.4	27.0	27.1	27.3	27.3	27.2	27.2	27.1	27.2	26.3	25.6	24.4	23.3	22.3	21.5	20.7	21.4	25.115
37.4	27.7	27.7	27.8	28.1	27.8	27.8	27.7	28.0	26.7	26.1	24.9	23.7	22.6	21.7	20.8	21.7	26.619
38.4	28.0	28.0	28.6	28.4	28.2	28.2	28.0	28.2	27.1	26.2	25.4	23.8	22.9	22.0	20.7	21.5	28.135
39.4	28.5	28.5	28.9	28.9	28.6	28.6	28.6	28.5	27.5	26.5	25.3	24.0	23.0	22.1	20.8	21.7	29.663
40.4	28.9	28.8	29.6	29.2	28.9	29.1	28.7	28.6	27.5	26.7	25.7	24.2	23.2	22.0	20.7	21.5	31.215
41.4	29.2	29.2	30.0	29.5	29.4	29.4	29.0	29.1	28.1	27.1	25.9	24.5	23.3	22.4	20.7	21.6	32.743

42.4	29.5	29.7	29.7	30.0	29.6	29.8	29.6	29.5	28.1	27.2	26.2	24.7	23.5	22.4	20.9	21.5	34.288
43.4	29.8	29.8	30.5	30.4	30.1	30.1	29.7	29.7	28.5	27.7	26.5	24.9	23.9	22.7	20.9	21.6	35.852
44.4	30.1	30.3	30.4	30.6	30.4	30.5	30.3	30.1	28.8	27.9	26.5	25.1	24.0	22.8	20.9	21.7	37.396
45.4	30.5	30.6	30.5	30.9	30.7	30.7	30.3	30.3	29.0	28.0	26.8	25.4	24.5	22.8	20.7	21.4	38.932
46.4	30.6	30.9	30.8	31.1	30.9	31.0	30.6	30.6	29.2	28.5	27.1	25.4	24.5	23.1	20.9	21.5	40.482
47.4	31.0	31.1	31.2	31.3	31.3	31.3	30.8	30.6	29.3	28.5	27.1	25.6	24.5	23.2	20.9	21.5	42.036
48.4	31.1	31.4	31.1	31.8	31.6	31.5	31.3	31.0	29.8	28.9	27.4	25.8	24.6	22.6	20.8	21.3	43.567
49.4	31.5	31.6	32.2	32.0	31.7	31.8	31.5	31.4	29.9	29.2	27.7	25.9	24.6	22.4	20.8	21.4	45.094
50.4	31.6	32.0	32.4	32.1	32.1	32.1	31.8	31.7	30.1	29.1	27.7	26.0	24.8	22.4	21.0	21.5	46.607
51.4	31.8	32	31.4	32.4	32.1	32.3	31.9	31.8	30.5	29.4	27.8	26.3	24.7	22.4	20.9	21.6	48.128
52.4	32.3	32.6	32.9	32.8	32.5	32.7	32.1	31.9	30.6	29.6	27.8	26.1	25.2	23.0	20.9	21.6	49.723
53.4	32.4	32.7	32.5	32.9	32.7	32.8	32.3	32.2	30.8	29.8	28.1	26.4	25.1	23.1	21.0	21.8	51.258
54.4	32.4	33.0	33.4	33.1	32.8	33.0	32.5	32.5	31.2	30.0	28.1	26.5	25.2	22.9	20.9	21.6	52.802
55.4	32.5	32.9	32.9	33.2	32.9	33.0	32.6	32.5	31.1	30.0	28.3	26.6	25.2	23.1	20.9	21.5	54.320
56.4	32.7	33.0	33.7	33.3	33.2	33.3	32.9	32.7	31.1	30.2	28.4	26.5	25.2	23.0	20.9	21.5	55.833
57.4	33.1	33.4	33.5	33.7	33.5	33.6	32.9	32.8	31.5	30.3	28.4	26.9	25.5	22.9	20.9	21.5	57.364
58.4	32.8	33.4	33.1	33.5	33.3	33.4	32.8	32.8	31.4	30.4	28.3	26.9	25.5	23.0	21.0	21.6	58.882
59.4	33.0	33.6	33.5	33.8	33.7	33.7	33.4	33.1	31.5	30.8	28.6	26.9	25.4	22.9	20.9	21.7	60.411
60.4	33.4	33.8	33.5	34.1	33.8	33.8	33.3	33.2	31.8	30.8	29.1	27.1	25.7	23.6	20.9	21.6	61.939
61.4	33.6	34.0	33.8	34.1	33.8	34.0	33.6	33.3	31.7	30.8	28.9	27.3	25.8	23.4	21.1	21.7	63.438
62.4	33.7	34.1	34.1	34.2	34.1	34.4	33.7	33.5	32.0	30.9	28.9	27.2	25.9	23.5	21.2	21.7	64.974
63.4	34.0	34.5	34.5	34.6	34.3	34.5	33.9	33.7	32.3	31.1	29.0	27.6	26.2	23.9	21.0	21.6	66.538
64.4	33.7	34.3	34.7	34.5	34.3	34.4	33.9	33.7	32.3	31.3	29.2	27.7	26.1	23.6	20.9	21.7	68.107
65.4	34.3	34.5	33.8	34.8	34.6	34.6	34.2	33.9	32.4	31.6	29.5	27.8	26.3	24.0	21.0	21.7	69.666
66.4	34.3	34.8	34.5	35.0	34.9	34.8	34.3	34.2	32.6	31.4	29.6	27.9	26.3	24.0	21.0	21.7	71.263
67.4	34.4	34.9	35.4	35.2	34.9	35.0	34.5	34.0	32.5	31.7	29.5	27.8	26.5	24.1	21.3	21.9	72.859
68.4	34.6	35.1	35.4	35.2	35.2	35.1	34.5	34.2	32.9	31.8	[illegible]	28.0	26.7	24.4	21.0	21.6	74.453
69.4	34.6	35.2	[illegible]	35.3	35.0	35.3	34.8	34.2	32.9	31.7	30.1	28.2	26.6	24.1	21.1	21.8	76.053
70.4	34.6	35.3	34.9	35.2	35.2	35.3	34.8	34.5	32.9	31.7	29.6	28.0	26.6	24.1	21.0	21.9	77.641
71.4	34.7	35.3	34.9	35.4	35.2	35.2	34.8	34.6	32.9	32.0	29.8	28.3	26.7	24.2	21.0	21.9	79.259
72.4	34.6	35.3	34.9	35.5	35.3	35.3	34.8	34.5	33.2	32.0	30.1	28.2	26.6	24.3	21.2	21.7	80.879
73.4	34.6	35.3	35.7	35.5	35.5	35.5	35.1	34.6	33.1	32.0	29.9	28.3	26.9	24.4	21.3	21.8	82.504
74.4	34.7	35.4	34.5	35.5	35.5	35.5	35.0	34.8	33.3	32.3	30.1	28.4	27.1	24.8	21.2	21.4	84.092
75.4	34.9	35.3	35.1	35.6	35.5	35.5	35.1	34.6	33.2	32.1	30.0	28.5	26.9	24.4	21.1	21.6	85.698
76.4	34.9	35.6	35.1	35.6	35.5	35.6	35.0	34.8	33.3	32.2	30.2	28.5	27.1	24.4	21.5	21.7	87.308
77.4	34.9	35.6	34.9	35.6	35.5	35.6	35.0	35.0	33.4	32.3	30.1	28.7	27.0	24.4	21.2	21.6	88.910
78.4	34.9	35.6	34.6	35.7	35.6	35.6	35.2	34.8	33.3	32.2	30.2	28.6	27.1	24.7	21.2	21.5	90.482
79.4	34.6	35.6	34.4	35.8	35.6	35.6	35.3	35.0	33.5	32.4	30.3	28.7	27.2	24.6	21.1	21.7	92.064
80.4	35.2	35.8	35.1	35.9	35.7	35.8	35.3	35.1	33.5	32.4	30.2	28.8	27.2	24.6	21.2	21.6	93.654
81.4	35.0	35.7	35.5	35.8	35.6	35.7	35.2	35.0	33.6	32.5	30.4	28.8	27.3	25.0	21.2	21.7	95.236
82.4	35.4	35.6	35.4	35.7	35.5	35.6	35.3	35.0	33.4	32.5	30.6	28.6	27.2	25.0	21.3	21.5	96.830
83.4	34.9	35.6	35.7	35.8	35.7	35.7	35.3	35.0	33.4	32.5	30.5	28.8	27.5	25.0	21.1	21.6	98.425
84.4	35.2	35.6	35.3	35.8	35.7	35.8	35.0	34.8	33.4	32.4	30.3	28.7	27.3	24.8	21.5	21.6	99.989
85.4	35	[illegible]	35.3	35.8	35.5	35.6	35.1	35.0	33.4	32.4	30.3	28.9	27.3	24.8	21.2	21.6	101.588
86.4	[illegible]	35.7	36.1	35.8	35.6	35.7	35.1	35.0	33.5	32.5	30.4	28.9	27.6	25.2	21.4	21.6	103.181
87.4	35.3	35.7	34.5	35.7	35.6	35.7	35.1	35.1	33.5	32.3	30.5	28.9	27.5	25.1	21.4	21.6	104.758
88.4	35.1	35.6	36.1	35.9	35.5	35.6	35.2	35.0	33.6	32.3	30.3	29.0	27.4	25.3	21.3	21.6	106.356
89.4	35.2	35.8	34.6	35.8	35.5	35.7	35.0	35.0	33.4	32.3	30.4	29.0	27.5	25.1	21.4	21.6	107.952
90.4	35.2	35.5	35.3	35.8	35.5	35.6	35.2	35.0	33.7	32.6	30.6	28.8	27.4	25.2	21.3	21.3	109.544
91.4	35.1	35.6	35.1	35.8	35.5	35.7	35.1	35.1	33.7	32.5	30.7	29.0	27.5	25.0	21.5	21.7	111.117

92.4	35.0	35.7	34.6	35.6	35.5	35.6	35.2	35.0	33.5	32.6	30.7	29.0	27.6	25.1	21.6	21.9	112.694
93.4	35.2	35.6	35.1	35.5	35.3	35.4	35.0	34.8	33.5	32.6	30.5	28.9	27.6	25.0	21.4	21.7	114.283
94.4	35.3	35.7	35.1	35.6	35.4	35.5	35.0	34.8	33.5	32.5	30.6	28.9	27.6	25.3	21.7	21.7	115.831
95.5	34.9	35.5	35.5	35.6	35.4	35.7	34.9	34.9	33.5	32.5	30.7	29.0	27.3	25.2	21.6	21.8	117.415
96.5	35.0	35.6	34.6	35.7	35.5	35.4	35.1	34.8	33.6	32.3	30.5	29.2	27.6	25.1	21.5	21.6	118.982
97.5	34.9	35.7	35.6	35.6	35.5	35.5	35.1	34.9	33.5	32.3	30.4	28.8	27.4	24.9	21.7	21.8	120.538
98.5	35.0	35.6	35.3	35.8	35.5	35.7	35.2	35.1	33.4	32.6	30.5	28.9	27.4	25.3	21.7	21.7	122.087
99.5	35.0	35.6	34.5	35.6	35.5	35.7	35.0	34.8	33.5	32.6	30.7	29.1	27.5	25.2	21.7	21.5	123.646
100.5	34.7	35.5	35.6	35.3	35.3	35.4	35.0	34.8	33.5	32.3	30.3	28.9	27.5	24.8	21.7	21.9	125.194
101.5	35.0	35.4	36.0	35.8	35.5	35.4	35.1	34.9	33.5	32.6	30.5	28.9	27.4	25.1	21.6	21.7	126.740
102.5	35.3	35.7	36.1	35.6	35.5	35.7	35.1	34.9	33.6	32.5	30.5	29.2	27.7	25.1	21.7	21.7	128.261
103.5	35.1	35.6	35.7	35.8	35.5	35.7	35.0	35.0	33.3	32.2	30.4	28.9	27.4	25.1	21.8	21.8	129.834
104.5	35.0	35.7	35.4	35.8	35.6	35.5	35.1	35.0	33.4	32.5	30.7	29.2	27.8	25.2	21.7	21.7	131.354
105.5	35.2	35.6	35.3	35.7	35.6	35.5	35.2	34.8	33.4	32.7	30.5	29.0	28.0	25.1	21.7	21.9	132.901
106.5	35.1	35.7	35.3	35.7	35.5	35.5	34.9	34.7	33.4	32.3	30.4	29.0	27.4	25.1	21.8	22.0	134.442
107.5	35.4	35.8	35.4	35.8	35.6	35.7	35.2	34.9	33.4	32.5	30.6	29.0	27.6	25.1	21.8	22.0	135.975
108.5	35.3	35.7	36.0	35.7	35.6	35.7	35.2	34.9	33.5	32.5	30.6	29.0	27.7	25.4	21.7	21.9	137.465
109.5	35.1	35.5	35.3	35.7	35.7	35.8	35.2	35.1	33.5	32.6	30.7	29.1	27.9	25.1	21.8	22.1	139.010
110.5	35.3	35.6	35.4	35.7	35.6	35.6	35.2	35.0	33.5	32.4	30.5	29.1	27.7	25.3	22.0	21.9	140.561
111.5	35.2	35.8	35.4	35.7	35.6	35.5	35.1	34.9	33.4	32.4	30.6	29.0	27.7	25.2	21.8	22.0	142.083
112.5	35.2	35.7	35.5	35.7	35.6	35.8	35.2	35.0	33.5	32.5	30.6	29.0	27.7	25.6	21.8	21.9	143.629
113.5	35.1	35.5	34.8	35.7	35.6	35.7	35.2	34.9	33.4	32.5	30.5	29.0	27.7	25.1	21.9	21.8	145.153
114.5	35.3	35.7	35.1	35.9	35.6	35.5	35.1	35.0	33.6	32.5	30.7	29.2	27.6	25.5	22.0	21.8	146.707
115.5	35.4	35.6	35.5	35.9	35.7	35.6	35.3	35.0	33.7	32.5	30.5	29.1	27.8	25.4	21.8	22.1	148.230
116.5	35.2	35.9	35.2	36.0	35.7	35.7	35.3	35.0	33.6	32.6	30.7	29.1	27.7	25.2	21.9	22.0	149.774
117.5	35.2	35.7	35.1	35.9	35.7	35.9	35.2	35.0	33.7	32.4	30.9	29.2	27.8	25.2	22.0	21.9	151.316
118.5	35.4	35.7	35.0	35.8	35.7	35.8	35.3	35.0	33.6	32.6	30.5	29.3	28.0	25.4	21.9	21.9	152.813
119.5	35.2	35.7	36.0	35.9	35.7	35.6	35.2	35.0	33.4	32.5	30.6	29.1	27.8	25.4	21.9	22.1	154.352
120.5	35.2	35.6	36.2	35.8	35.6	35.9	35.3	35.0	33.4	32.5	30.6	29.2	27.8	25.4	22.1	21.9	155.892
121.5	35.1	35.6	35.2	35.7	35.7	35.6	35.3	34.9	33.7	32.7	30.8	29.3	27.8	25.4	21.9	22.0	157.425
122.5	35.5	35.6	36.0	35.8	35.6	35.7	35.1	35.0	33.3	32.4	30.7	29.1	27.8	25.7	22.0	22.0	158.971
123.5	35.2	35.6	35.5	35.8	35.5	35.6	35.3	34.8	33.4	32.5	30.7	29.4	27.9	25.3	22.0	21.9	160.524
124.5	35.2	35.6	36.3	35.5	35.4	35.5	35.0	34.8	33.2	32.3	30.4	29.0	27.7	25.4	22.0	22.1	162.062
125.5	35.0	35.5	34.5	35.6	35.4	35.6	35.1	34.8	33.4	32.5	30.8	29.3	27.9	25.8	22.1	22.1	163.618
126.5	35.0	35.4	35.2	35.4	35.3	35.2	34.8	34.7	33.1	32.5	30.6	29.0	27.8	25.5	21.9	22.2	165.157
127.5	35.0	35.4	34.5	35.6	35.3	35.3	34.9	34.8	33.1	32.4	30.6	29.2	27.8	25.4	22.2	22.2	166.698
128.5	34.7	35.1	35.0	35.3	35.0	35.1	34.8	34.6	33.3	32.3	30.4	29.1	27.7	25.3	22.2	22.0	168.211
129.5	34.4	35.1	34.7	35.0	34.7	34.9	34.3	34.4	33.1	32.0	30.3	28.9	27.7	25.0	22.1	22.1	169.731
130.5	34.5	35.1	35.2	35.3	34.9	35.1	34.6	34.5	32.9	31.9	30.2	29.1	27.4	25.0	22.3	22.0	171.227
131.5	34.7	35.1	35.5	35.1	35.0	35.1	34.6	34.4	33.0	31.9	30.2	28.9	27.6	25.1	22.3	22.1	172.734
132.5	34.7	35.1	35.5	35.3	35.1	35.1	34.7	34.5	33.0	32.1	30.3	28.9	27.7	25.6	22.3	22.2	174.234
133.5	34.7	[illegible]	35.3	35.2	34.7	35.1	34.6	34.4	33.0	32.1	30.4	29.0	27.9	25.3	22.3	22.2	175.768
134.5	34.5	35.0	34.8	35.1	35.0	35.1	34.7	34.4	33.2	32.2	30.3	29.0	27.7	25.5	22.1	22.1	177.247
135.5	34.4	34.9	34.5	34.9	34.7	34.7	34.3	34.3	32.6	31.7	30.0	28.7	27.4	25.1	22.2	22.1	178.744
136.5	34.6	34.9	35.2	35.0	34.9	35.0	34.6	34.3	33.0	32.1	30.2	28.8	27.5	25.5	22.3	22.0	180.259
137.5	34.5	35.1	35.6	35.0	34.9	35.0	34.6	34.4	32.8	31.8	30.2	28.9	27.6	25.4	22.2	22.1	181.767
138.5	34.4	34.9	34.5	34.8	34.7	34.9	34.3	34.0	32.7	31.9	30.1	28.7	27.6	25.4	22.1	21.9	183.263
139.5	34.5	35.0	35.6	35.1	34.8	35.0	34.4	34.1	32.9	31.9	30.5	29.0	27.6	25.4	22.2	22.0	111.767
140.5	34.5	35.0	34.9	35.1	34.8	35.0	34.4	34.4	33.1	31.9	30.3	28.8	27.5	25.7	22.1	22.3	2.478
141.5	34.4	34.9	34.7	35.0	34.7	34.9	34.3	34.3	32.7	31.8	30.1	28.9	27.6	25.3	22.1	21.8	3.969

142.5	34.5	34.8	34.6	35.1	34.8	35.0	34.4	34.3	32.9	31.9	30.2	28.9	27.4	25.6	22.3	22.1	5.500
143.5	34.4	34.9	34.7	34.9	34.7	34.7	34.4	34.1	32.8	31.9	30.0	28.7	27.5	25.1	22.3	21.9	7.028
144.5	34.2	34.6	34.3	34.8	34.7	34.7	34.3	34.1	32.7	31.7	29.9	28.9	27.5	25.0	22.1	22.0	8.508
145.5	34.2	34.7	34.3	34.7	34.5	34.7	34.3	34.1	32.8	31.8	30.0	28.7	27.5	25.4	22.4	22.1	10.007
146.5	34.5	34.8	33.9	34.8	34.5	34.8	34.1	34.1	32.8	31.8	30.0	28.7	27.4	25.1	22.3	22.1	11.519
147.5	34.2	34.6	34.4	34.8	34.4	34.4	34.1	34.0	32.8	31.7	30.0	28.5	27.3	25.2	22.6	22.2	13.029
148.5	34.4	34.7	34.6	34.8	34.6	34.7	34.2	34.1	32.8	31.9	30.1	28.9	27.5	25.4	22.3	22.1	14.486
149.5	34.5	34.9	34.3	35.0	34.8	34.7	34.2	34.3	32.8	31.8	30.2	28.8	27.4	25.5	22.5	22.1	16.024
150.5	34.5	35.0	34.3	35.1	34.8	34.7	34.3	34.3	32.8	31.9	30.3	29.0	27.5	25.4	22.4	22.0	17.559
151.5	34.5	35.0	35.3	35.1	34.8	34.7	34.3	34.2	32.9	32.0	30.3	28.8	27.7	25.4	22.4	22.0	19.074
152.5	34.5	35.0	34.7	35.0	35.0	34.9	34.4	34.2	32.9	31.8	30.4	29.0	27.7	25.5	22.4	22.1	20.613
153.5	34.4	34.8	34.4	34.8	34.5	35.0	34.4	34.1	32.8	31.7	30.1	28.8	27.6	25.2	22.5	22.2	22.161
154.5	34.4	34.9	34.5	34.8	34.6	34.8	34.4	34.2	32.8	32.0	30.3	28.9	27.7	25.6	22.5	22.1	23.659
155.5	34.2	34.7	34.3	34.6	34.5	34.7	34.1	34.1	32.8	31.8	30.0	28.7	27.5	24.9	22.5	22.1	25.241
156.5	34.5	34.8	34.5	34.9	34.6	34.8	34.4	34.1	32.9	31.8	30.2	28.9	27.6	25.5	22.4	22.1	26.788
157.5	34.3	34.8	34.3	35.0	34.5	34.7	34.2	34.1	32.7	31.8	30.3	29.0	27.6	25.2	22.4	22.0	28.326
158.5	34.5	34.7	34.5	34.9	34.6	34.7	34.4	34.1	32.6	31.7	30.2	28.9	27.6	25.4	22.4	22.1	29.842
159.5	34.3	34.6	34.1	34.8	34.5	34.6	34.1	33.8	32.8	31.5	30.0	28.6	27.4	25.3	22.4	22.1	31.322
160.5	34.3	34.7	34.5	34.8	34.5	34.7	34.4	34.1	32.8	31.8	30.3	28.7	27.5	25.3	22.6	22.2	32.856
161.5	34.5	34.8	34.5	34.8	34.5	34.8	34.3	34.1	32.8	31.9	30.3	28.8	27.5	25.4	22.5	22.1	34.354
162.5	34.5	34.9	35.2	34.8	34.7	34.7	34.3	34.1	32.8	31.9	30.4	28.8	27.5	25.4	22.5	22.0	35.885
163.5	34.3	34.6	34.7	34.7	34.5	34.6	34.1	34.1	32.7	31.7	30.0	28.7	27.3	25.2	22.4	22.1	37.408
164.5	34.5	34.7	34.0	34.8	34.5	34.7	34.3	34.0	32.8	31.8	30.1	28.7	27.5	25.4	22.6	22.2	38.937
165.5	34.4	34.8	34.4	34.9	34.6	34.8	34.4	34.2	32.9	31.9	30.1	28.8	27.5	25.3	22.6	22.2	40.482
166.5	34.2	34.6	34.3	34.8	34.5	34.7	34.1	34.1	32.8	31.7	30.2	28.7	27.4	25.4	22.4	22.1	42.020
167.5	34.5	34.5	34.7	34.8	34.6	34.7	34.4	34.1	32.7	31.9	30.1	28.7	27.7	25.1	22.6	22.1	43.564
168.5	34.1	34.6	34.8	34.7	34.3	34.7	34.1	34.1	32.9	31.9	30.1	28.9	27.6	25.4	22.6	22.0	45.096
169.5	34.0	34.7	34.2	34.6	34.5	34.4	34.0	34.0	32.8	31.7	29.9	28.7	27.3	25.4	22.6	22.1	46.590
170.5	34.0	34.5	34.1	34.6	34.5	34.4	34.2	34.0	32.8	31.8	30.0	28.7	27.4	25.3	22.4	22.1	48.153
171.5	34.0	34.6	34.0	34.6	34.5	34.6	34.1	34.0	32.6	-31.6	29.9	28.7	27.4	25.4	22.7	22.1	49.646
172.5	34.3	34.6	34.5	34.7	33.5	34.2	34.2	33.9	32.8	31.6	30.1	28.7	27.3	25.1	22.7	22.2	51.163
173.5	34.1	34.4	34.0	34.6	33.9	34.4	34.0	34.2	32.5	31.6	29.8	28.7	27.3	25.2	22.5	22.2	52.650
174.5	34.1	34.5	34.3	34.6	34.2	34.5	34.1	34.0	32.6	31.7	29.9	28.5	27.2	25.2	22.5	22.2	54.110
175.5	34.1	34.7	34.4	34.7	34.5	34.6	34.1	33.9	32.6	31.7	30.1	28.8	27.4	25.2	22.6	22.4	55.629
176.5	34.3	34.8	34.3	34.7	34.5	34.7	34.1	33.9	32.6	31.7	30.1	28.8	27.5	25.5	22.8	22.2	57.161
177.5	34.2	34.6	35.0	34.7	34.6	34.5	34.2	34.1	32.8	31.7	30.1	28.8	27.6	25.2	22.6	22.2	58.688
178.5	34.3	34.7	34.3	34.8	34.6	34.6	34.3	34.1	32.9	32.0	30.1	28.9	27.5	25.3	22.6	22.2	60.201
179.5	34.3	34.8	34.1	34.8	34.5	34.6	34.2	34.2	32.8	31.7	30.3	29.0	27.7	25.5	22.4	22.2	61.744
180.5	34.6	34.8	34.6	34.9	34.6	34.7	34.4	34.2	32.8	31.9	30.2	28.9	27.5	25.5	22.6	22.1	63.279
181.5	34.5	34.8	34.3	34.9	34.6	34.8	34.2	34.1	32.8	32.1	30.1	28.9	27.5	25.4	22.7	22.0	64.813
182.5	34.5	34.7	34.4	34.9	34.6	34.8	34.2	34.1	32.7	31.9	30.4	28.7	27.5	25.2	22.6	22.3	66.368
183.5	34.1	34.5	34.6	34.4	34.3	34.5	34.2	33.9	32.7	31.5	29.9	28.7	27.5	25.3	22.5	22.2	67.911
184.5	34.1	34.5	34.6	34.6	34.3	34.5	34.2	33.8	32.6	31.7	30.2	28.6	27.5	25.3	22.7	22.2	69.426
185.5	34.2	34.5	34.5	34.6	34.3	34.5	33.9	33.7	32.4	31.7	30.1	28.9	27.4	25.3	22.7	22.1	70.969
186.5	34.5	34.5	34.2	34.7	34.3	34.3	33.9	33.8	32.3	31.7	29.9	28.5	27.8	25.0	22.6	22.2	72.500
187.5	34.1	34.4	34.1	34.4	34.2	34.2	33.8	33.9	32.3	31.5	29.9	28.8	27.5	25.2	22.8	22.0	74.060
188.5	34.1	34.3	34.4	34.5	34.1	34.2	33.9	33.7	32.3	31.3	29.8	28.8	27.5	25.2	22.8	22.1	75.584
189.5	33.8	34.2	33.7	34.1	33.8	34.2	33.7	33.6	32.1	31.3	29.8	28.8	27.5	25.3	22.8	22.1	77.128
190.5	34.0	34.2	34.5	34.0	34.0	34.2	33.8	33.6	32.2	31.2	29.7	28.4	27.3	25.2	22.7	22.2	78.667
191.5	33.6	34.1	33.5	34.3	33.8	33.9	33.6	33.4	32.2	31.1	29.4	28.4	27.3	25.2	22.8	22.0	80.164

192.5	33.5	33.8	33.5	33.9	33.8	33.7	33.3	33.3	31.8	31.1	29.5	28.4	27.4	24.9	22.6	22.1	81.673
193.5	33.0	33.5	33.0	33.1	32.8	33.4	33.1	33.2	32.0	31.0	29.5	28.5	27.3	25.0	22.8	22.0	83.185
194.5	33.6	33.9	33.6	33.9	33.6	33.7	33.4	33.3	32.1	31.1	29.8	28.5	27.2	24.9	22.6	21.9	84.689
195.5	33.6	33.8	33.5	34.0	33.7	33.7	33.4	33.3	32.0	31.2	29.5	28.5	27.2	25.0	22.8	22.2	86.227
196.5	33.5	33.8	33.5	34.0	33.4	33.7	33.3	33.2	32.0	31.1	29.5	28.2	27.2	25.0	22.7	22.2	87.752
197.5	33.7	33.9	34.1	34.0	33.7	33.8	33.4	33.4	32.1	31.1	29.6	28.5	27.3	25.0	22.8	22.1	89.276
198.5	33.5	33.7	33.6	33.8	33.7	33.8	33.4	33.4	32.0	31.3	29.8	28.5	27.2	25.0	22.8	22.1	90.791
199.5	33.4	33.6	33.2	33.9	33.7	33.9	33.7	33.1	32.1	31.2	30.0	28.6	27.3	25.0	22.8	21.9	92.333
200.5	33.7	33.9	33.5	33.8	33.8	33.9	33.4	33.5	32.0	31.2	29.8	28.4	27.4	25.0	22.8	22.2	93.865
201.5	33.6	33.8	33.0	34.0	33.7	33.9	33.4	33.3	32.1	31.1	29.6	28.5	27.3	25.0	22.6	21.9	95.394
202.5	33.6	33.8	33.8	33.8	33.8	33.9	33.4	33.4	32.0	31.3	29.6	28.4	27.2	25.1	22.8	22.2	96.954
203.5	33.6	33.9	33.6	33.9	33.8	33.8	33.4	33.4	32.1	31.4	29.6	28.5	27.3	24.9	22.8	22.2	98.498
204.5	33.3	33.7	32.8	33.9	33.8	34.0	33.6	33.4	31.9	31.1	29.6	28.3	27.2	25.2	22.7	22.3	100.025
205.5	33.5	33.7	34.2	33.8	33.7	33.7	33.4	33.3	32.2	31.4	29.8	28.5	27.3	25.0	22.8	22.2	101.555
206.5	33.3	33.7	33.5	34.0	33.7	33.9	33.4	33.3	32.1	31.0	29.4	28.3	27.2	25.0	22.8	22.1	103.110
207.5	33.5	33.9	33.7	33.9	33.7	33.8	33.4	33.4	31.9	31.1	29.6	28.3	27.3	25.0	22.8	22.1	104.623
208.5	33.6	33.9	34.0	33.8	33.7	33.7	33.4	33.3	32.0	31.1	29.5	28.5	27.4	24.9	23.0	22.2	106.125
209.5	33.8	33.9	33.5	34.1	33.7	33.7	33.7	33.4	32.1	31.0	29.6	28.6	27.1	24.9	22.8	22.2	107.660
210.5	33.6	33.9	33.5	34.0	33.7	33.7	33.3	33.3	32.0	31.2	29.6	28.4	27.2	24.9	22.8	22.1	109.197
211.5	33.4	33.6	33.5	33.8	33.7	33.8	33.4	33.2	32.0	31.1	29.5	28.3	27.3	24.9	22.9	22.0	110.717
212.5	33.3	33.7	33.5	33.8	33.5	33.6	33.3	33.2	31.8	30.8	29.4	28.1	27.1	24.9	22.7	22.1	112.237
213.5	33.5	33.7	33.6	33.8	33.8	33.7	33.3	33.3	31.9	31.1	29.4	28.5	27.2	24.9	22.7	22.1	113.775
214.5	33.8	33.9	33.4	34.2	33.8	33.9	33.3	33.4	32.1	31.2	29.6	28.5	27.2	25.1	22.7	22.2	115.221
215.5	33.2	33.7	33.3	33.6	33.4	33.6	33.2	33.1	31.8	31.1	29.7	28.5	27.3	24.8	22.7	22.1	116.801
216.5	33.7	33.7	33.1	33.9	33.5	34.0	33.4	33.2	32.1	31.1	29.4	28.3	27.2	24.9	22.8	22.1	118.320
217.5	33.5	33.8	34.4	34.2	33.8	33.9	33.5	33.4	32.2	31.2	29.7	28.6	27.3	25.0	22.9	22.2	119.835
218.5	33.5	34.0	33.6	34.0	33.8	34.0	33.6	33.3	32.0	31.1	29.8	28.4	27.2	25.1	22.8	22.2	121.324
219.5	33.6	34.0	33.2	34.2	33.9	34.0	33.7	33.4	32.2	31.4	29.7	28.5	27.4	25.1	22.9	22.2	122.838
220.5	33.8	34.2	34.0	34.2	33.9	34.1	33.6	33.6	32.2	31.4	29.5	28.6	27.3	25.1	22.9	22.3	124.348
221.5	33.8	34.1	34.4	34.2	33.9	34.0	33.5	33.6	32.3	31.4	29.7	28.5	27.5	25.3	22.9	22.2	125.836
222.5	33.8	34.2	33.5	34.3	34.1	34.0	33.7	33.7	32.2	31.4	29.6	28.7	27.3	25.5	22.9	22.2	127.331
223.5	33.8	34.0	34.2	34.3	34.1	34.0	33.9	33.7	32.4	31.4	29.9	28.5	27.4	25.6	22.8	22.0	128.829
224.5	33.7	34.0	33.7	34.2	33.9	34.0	33.7	33.4	32.2	31.2	29.6	28.3	27.3	24.8	22.9	22.1	130.298
225.5	33.8	34.1	33.3	34.4	34.1	34.2	33.7	33.6	32.4	31.3	29.9	28.6	27.5	25.4	22.7	22.3	131.803
226.5	33.9	33.9	33.9	34.5	34.1	34.0	33.7	33.6	32.2	31.5	29.6	28.6	27.4	25.0	23.0	22.1	133.286
227.5	33.7	34.1	33.9	34.2	33.9	34.0	33.5	33.3	32.1	31.3	29.5	28.3	27.1	25.2	22.8	22.3	134.772
228.5	33.8	34.0	33.1	34.2	34.0	33.9	33.5	33.4	32.1	31.3	29.8	28.4	27.1	25.2	22.8	22.2	136.240
229.5	33.8	34.0	33.7	34.2	33.9	34.1	33.6	33.4	32.1	31.1	29.6	28.3	27.1	25.2	22.9	22.1	137.704
230.5	33.4	34.0	33.7	34.1	33.8	34.0	33.5	33.4	31.9	31.0	29.4	28.4	27.1	24.6	22.9	22.2	139.184
231.5	33.9	34.2	34.2	34.2	34.1	34.1	33.7	33.6	32.1	31.3	29.8	28.6	27.3	25.4	22.9	22.3	140.626
232.5	33.7	34.0	34.0	34.3	34.1	34.0	33.7	33.6	32.3	31.3	29.9	28.4	27.3	25.1	23.0	22.3	142.092
233.5	33.5	34.1	33.6	34.1	34.0	34.1	33.7	33.4	32.1	31.2	29.5	28.3	27.3	25.1	22.9	22.2	143.582
234.5	33.9	34.0	33.9	34.3	34.1	34.0	33.7	33.5	32.1	31.2	29.9	28.5	27.2	25.3	23.0	22.0	145.053
235.5	34.1	34.2	33.7	34.4	34.1	34.1	33.7	33.5	32.2	31.2	30.0	28.5	27.5	25.1	22.9	22.3	146.544
236.5	33.9	34.3	34.0	34.4	34.1	34.0	33.7	33.4	32.2	31.4	29.6	28.4	27.4	25.2	23.0	22.2	148.038
237.5	34.2	34.3	34.0	34.2	34.0	34.3	33.9	33.7	32.4	31.2	29.6	28.5	27.2	25.2	23.1	22.2	149.574
238.5	34.1	34.5	34.8	34.4	34.2	34.3	33.9	33.5	32.3	31.5	29.7	28.6	27.4	25.1	23.0	22.2	151.075
239.5	34.1	34.3	34.2	34.5	34.2	34.3	34.0	33.7	32.3	31.3	29.8	28.5	27.4	25.3	23.0	22.1	152.591
240.5	34.1	34.3	34.0	34.4	34.1	34.3	33.7	33.6	32.4	31.6	29.8	28.5	27.3	25.0	22.9	22.1	154.100
241.5	34.1	34.3	33.9	34.4	34.1	34.0	33.7	33.6	32.3	31.5	29.7	28.6	27.4	25.1	22.9	22.2	155.627

242.5	33.9	34.1	34.4	34.2	34.1	34.0	33.7	33.6	32.3	31.3	29.6	28.6	27.2	25.2	23.1	22.2	157.149
243.5	34.0	34.3	34.1	34.4	34.1	34.3	34.0	33.7	32.3	31.5	29.9	28.5	27.3	25.0	22.9	22.3	158.664
244.5	33.5	34.1	33.2	34.0	33.6	34.0	33.5	33.4	32.2	31.2	29.6	28.5	27.2	24.8	23.0	22.2	160.149
245.5	33.8	34.0	34.4	34.4	34.1	34.1	33.9	33.6	32.4	31.4	29.8	28.5	27.4	25.1	22.9	22.2	161.644
246.5	33.6	34.0	33.2	34.1	33.9	34.0	33.5	33.5	32.2	31.1	29.5	28.3	27.3	24.7	22.9	22.2	163.123
247.5	34.0	34.1	34.2	34.4	34.2	34.1	33.8	33.6	32.3	31.6	30.2	28.7	27.4	25.2	23.1	22.3	164.620
248.5	34.0	34.3	33.5	34.4	34.1	34.2	33.8	33.6	32.2	31.4	29.7	28.5	27.3	25.1	23.2	22.2	166.093
249.5	33.8	34.2	33.9	34.2	33.9	34.1	33.8	33.6	32.3	31.5	30.0	28.6	27.3	25.0	23.1	22.3	167.594
250.5	33.7	34.0	33.6	34.0	33.8	34.0	33.4	32.5	31.7	30.7	29.5	28.3	27.0	25.0	23.0	22.3	169.102
251.5	33.4	33.7	33.2	33.6	33.2	33.4	33.1	32.5	31.4	30.5	29.3	28.1	27.1	24.6	23.0	22.3	170.596
252.5	33.1	33.2	32.9	33.2	33.0	33.0	32.5	32.2	31.1	30.3	29.1	28.2	27.0	24.5	22.9	22.2	172.131
253.5	32.5	32.9	32.7	33.0	32.6	32.5	32.1	31.8	30.7	29.9	28.8	28.0	27.2	24.4	22.9	22.2	173.700
254.5	32.3	32.5	32.3	32.3	32.2	32.1	31.7	31.5	30.5	29.7	28.7	27.9	27.0	24.2	23.1	22.2	175.255
255.5	32.2	32.3	32.0	32.3	31.9	32.0	31.4	31.4	30.3	29.4	28.4	27.9	27.1	24.3	23.0	22.1	176.860
256.5	31.8	31.9	31.6	31.8	31.5	31.5	31.1	31.0	29.9	29.2	28.5	27.6	27.1	24.1	23.2	22.4	178.449
257.5	31.3	31.3	31.2	31.3	30.9	30.9	30.7	30.5	29.5	28.7	27.3	27.4	26.7	24.2	23.0	22.3	180.084
258.5	31.0	31.0	30.9	31.0	30.6	30.8	30.2	30.2	29.1	28.5	27.7	27.4	26.7	25.1	23.1	22.2	181.673
259.5	30.6	30.8	30.3	30.7	30.3	30.4	30.0	30.0	28.9	28.5	27.6	27.3	26.4	25.3	23.0	21.8	183.262
260.5	30.4	30.3	30.3	30.5	30.1	30.2	29.9	29.9	28.7	28.2	27.6	27.2	26.7	25.7	23.1	22.1	184.860
261.5	30.0	30.0	29.9	30.1	29.7	29.9	29.5	29.5	28.6	28.0	27.4	26.9	26.5	25.8	23.1	21.8	186.423
262.5	29.8	29.7	29.7	29.8	29.4	29.4	29.2	29.2	28.3	27.7	27.0	26.6	26.4	25.7	23.0	22.1	188.036
263.5	29.6	29.6	29.7	29.8	29.4	29.4	29.2	29.1	28.3	27.7	27.1	26.8	26.3	25.9	23.4	22.1	189.654
264.5	29.1	29.1	29.0	29.2	29.1	29.1	28.7	28.7	27.8	27.3	26.8	26.5	26.3	25.6	23.0	22.0	191.218
265.5	29.2	29.0	28.9	29.0	28.8	28.9	28.6	28.7	27.7	27.3	26.9	26.3	26.0	25.7	23.2	22.1	192.815
266.5	28.8	28.8	28.6	28.8	28.5	28.5	28.3	28.3	27.5	27.0	26.5	26.2	25.8	25.6	23.2	22.2	194.415
267.5	28.8	28.7	28.5	28.6	28.3	28.4	28.4	28.4	27.3	26.9	26.6	26.2	25.8	25.6	23.2	22.4	196.000
268.5	28.6	28.3	28.3	28.2	28.2	28.1	27.9	28.1	27.4	27.0	26.4	26.2	25.6	25.6	23.2	22.3	197.563
269.5	28.4	28.1	28.2	28.2	27.9	28.0	27.8	28.0	27.1	26.7	26.6	26.0	25.7	25.4	23.1	22.0	199.148
270.5	28.2	27.9	28.0	28.0	27.8	27.9	27.8	27.6	27.0	26.7	26.1	25.8	25.6	25.2	23.0	22.0	200.743
271.5	28.2	27.9	27.7	27.9	27.7	27.7	27.6	27.6	26.9	26.4	26.4	26.2	24.6	25.4	23.0	22.2	202.320
272.5	27.9	27.8	27.6	27.6	27.4	27.5	27.4	27.5	26.6	26.2	26.0	26.0	25.3	25.0	23.0	22.3	203.906
273.6	28.0	27.6	27.5	27.7	27.5	27.4	27.3	27.4	26.7	26.2	26.1	26.0	25.6	24.5	23.0	22.3	205.397
274.6	27.8	27.4	27.4	27.4	27.2	27.4	27.1	27.2	26.4	26.2	25.9	25.9	25.7	25.3	23.1	22.2	206.913
275.6	27.5	27.3	27.2	27.5	27.1	27.1	27.1	27.1	26.4	26.2	25.9	25.7	25.4	25.0	22.8	22.3	208.460
276.6	27.4	27.1	27.1	27.2	26.8	27.1	26.8	26.9	26.2	25.8	25.6	25.4	25.3	25.1	23.0	22.4	2.258
277.6	27.4	27.0	26.8	27.0	26.8	26.8	26.8	26.8	26.1	25.9	25.7	25.5	25.3	24.9	22.9	22.2	3.803
278.6	27.1	26.8	26.9	26.9	26.7	26.7	26.7	26.5	26.0	25.6	25.5	25.4	25.3	25.0	23.1	22.1	5.383
279.6	27.1	26.7	26.6	26.8	26.5	26.6	26.5	26.7	25.8	25.5	25.6	25.4	25.1	24.9	23.0	22.1	6.994
280.6	26.9	26.7	26.6	26.6	26.3	26.6	26.5	26.5	25.8	25.6	25.4	25.2	25.0	24.9	23.1	22.3	8.609
281.6	26.8	26.4	26.5	26.6	26.3	26.5	26.2	26.4	25.7	25.3	25.2	25.1	25.0	24.7	23.0	22.2	10.223
282.6	26.8	26.4	26.3	26.4	26.2	26.4	26.2	26.2	25.6	25.3	25.2	24.9	24.9	24.2	23.0	22.3	11.866
283.6	26.6	26.2	26.1	26.3	26.1	26.1	26.2	26.4	25.4	25.2	25.1	24.9	24.7	24.5	23.1	22.1	13.511
284.6	26.5	26.1	26.1	26.2	25.9	26.0	26.1	26.2	25.2	25.1	25.1	25.0	24.8	24.2	23.0	22.4	15.148
285.6	26.5	26.1	26.2	26.2	25.9	26.0	25.9	26.1	25.4	25.0	24.9	24.9	24.7	24.2	22.9	22.3	16.811
286.6	26.3	25.9	26.1	26.1	25.8	26.0	25.9	25.9	25.1	24.9	24.9	24.8	24.6	24.3	22.9	22.4	18.467
287.6	26.2	25.9	25.8	26.0	25.7	25.9	25.5	25.8	25.1	24.8	24.9	24.7	24.7	24.2	23.0	22.2	20.102
288.6	26.3	25.8	25.8	25.9	25.6	25.7	25.5	25.7	25.1	24.8	24.7	24.6	24.7	24.1	23.0	22.4	21.764
289.6	26.1	25.8	25.7	25.9	25.6	25.7	25.5	25.7	25.0	24.7	24.6	24.5	24.5	24.1	23.0	22.3	23.419
290.6	26.1	25.6	25.8	25.6	25.4	25.4	25.5	25.5	25.1	24.7	24.7	24.6	24.3	23.9	23.0	22.3	25.073
291.6	25.9	25.5	25.4	25.5	25.5	25.5	25.5	25.5	24.9	24.6	24.5	24.6	24.3	23.8	22.9	22.1	26.720

Grooved Plate Dryout Experiment Data Sheet

Date: 21 Sep 92 Time: 1156 Run Designation: G2E5

Runtime (min)	Amps	Volts	Comments	Dryout Length
			Δt=21 sec ⇒ 15 flowmeter = 0.024 g/sec	
			I have the groove plugged but whole groove's full of fluid	
C9.4	1.136	13.25	Power on: trying to duplicate $Q_{c,max}$	
C31.4	1.133	13.20	Removed toothpicks from channel, P=14.96 W	
C46.4			Meniscus nearly depressed in far end of groove	
C59.4	1.133	13.23	I can make front stop near end of groove; considered this is near $Q_{c,max}$ T_l=31 C	
C64.4			steady state doesn't obtain T_l=32 C	4 cm
C66.4				6
C73.4	1.124	13.11	Dropped power to 14.736	8
C80.4				8.8
C82.4	1.092	12.76	Dropped power further to 13.934 W ⇒ Δt=24 sec	
C87.4	1.092	12.72	T_l=32 plate still isn't at steady state	9.8
C100.5			It seems hard to get steady state. T_l is still 32 C but front can't be stable further ahead than 11.5 cm. So stable front seems to be able to be 2 cm or so in length. Just when I think so, front moves forward.	13.4
110.5	1.090	12.73		7.6
			Restart computer at t=13:59 or watch time = 123 minutes	7.6

Grooved Plate Dryout Experiment Data Sheet Date: 21 Sep 92 Time: 1156 Run Designation: G2E5				
Runtime (min)	Amps	Volts	Comments	Dryout Length
C1.0			W=124.4 minutes	
C11.4				5.5
C12.4	1.091	12.72	135.8 on the watch so Δt=123.4	
C14.4			steady state → power off T_1=32C Note: this is a good steady state	5.5
W140.0			front beginning to move	
W144.9				4.0
W147.8				2.0
W150.7			Rewet!	0
C27.4	3.079	36.04	Upped power!	
C32.2	2.903	34.05	Adjusted power after looking at run T4	
C33.6			Emptied flask!	
C47.1	2.895	34.01	Not well defined front!	33
C57.2			T_9=59 C	41
C69.2			Note M_{dot} seems lower, T_9=64 C	
C97.6			Cleaned up large collection of dark gunk at front. T_9=60 C	42
?106.6			Swabbed whole groove Rewet to	42
C120.0	2.890	34.01	I've tried a number of times to move dryout front at 42 cm but it likes it there so call this steady state	
C122.0			Power off T_1=77 C	

Grooved Plate Dryout Experiment Data Sheet Date: 21 Sep 92 Time: 1156 Run Designation: G2E5				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			W 246.4 = C 123.0	
W247.5			Front already on the move	
W249.3	0	0		40
W250.8			Definitely pulling stuff off channel	38
W252.7			Walls as it moves forward	36
W254.2				34
W255.6				32
W257.1				30
W258.7				28
W260.0				26
W261.6				24
W262.5				22
W263.7				20
W265.2			T_5=42 C	18
W266.7				16
W268.5				14
W269.9			T_4=39 C	12
W271.5				10
W272.5				8
W273.4				6
W274.7			T_2=36 C	4
W276.0				2
W276.7			Rewet!	
C154.2				

Grooved Plate Dryout Experiment Data Sheet

Date: 21 Sep 92 Time: 1156 Run Designation: G2E5

Runtime (min)	Amps	Volts	Comments	Dryout Length
	2.903	34.01	Started up power again. Emptied flask!	
	2.893	34.01		35.6
C204.7	2.890	34.00	I swabbed out groove. It appears to come to where it was before T_1=77 C	42.2
C212.1			T_1=78 C steady state	42.1
C217.1	1.091	12.77	Cut power back to $Q_{c,max}$	
W343.1			Front on move	
W344.0				40.0
W346.1			Δt	38.0
W348.0				36.0
W349.9	1.096	12.80	Δt= 123.4 sec	34.0
W351.6				32.0
W354.2				30.0
W356.3			T_7=53 C	28.0
W358.0				26.0
W359.8				24.0
W361.0			T_6=49 C	22
W362.9				20
W364.8				18
W366.8	1.097	12.80		16
W369.3				14
W371.6			T_4=42 C	12
W374.2				10
W376.7			T_3=40 C	8

Grooved Plate Dryout Experiment Data Sheet Date: 21 Sep 92 Time: 1156 Run Designation: G2E5				
Runtime (min)	Amps	Volts	Comments	Dryout Length
W380.0				6
W384.0	1.094	12.77	T_2=37 C	4
W385.8			Puddle out 4 cm from dam	2
W388.0			Rewet T_1=36	
C275.2			Emptied flask T_1=35	
C284.2			Topped off upper tank T_1=34	
C286.2	1.140	13.31	Upped power slightly. Δt=123.35	
C300.2	1.234	14.42	Upped power T_1=33 C	
			Unlikely groove will dryout at this power. T=34. Perhaps cleaning/preparing surface has an effect	
C318.2			Plugged up groove	
C322.2			Power shut down Can use last few M_{dot}s to get flow not through groove ie at 15	
C333.2			Shutdown Δt=458.6 - 335.2 = 123.4	

RUN LETTER DESIGNATION: G2E5/A
DATE: 09-21-1992 TIME: 12:01:22
GROOVE NUMBER: 2
THE BAROMETRIC PRESSURE IS 28.78 MM OF MERCURY
THE FLOWMETER SETTING IS : 15
THE PLATE ANGLE IS 0 TIME IN MIN; SCALE IN GRAMS

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	SCALE
1.0	22.4	21.9	21.9	22.1	21.8	21.9	21.7	21.8	21.0	21.0	21.3	21.2	21.1	21.4	21.1	21.4	61.189
1.4	22.4	21.9	22.2	22.1	21.7	21.8	21.6	21.9	21.2	20.9	21.2	21.3	21.1	21.4	21.0	21.4	61.821
2.4	22.2	21.7	21.8	22.0	21.6	21.7	21.6	21.8	21.1	21.1	21.2	21.1	21.0	21.3	21.0	21.3	63.420
3.4	22.3	21.8	22.0	21.9	21.7	21.7	21.6	21.7	21.1	21.0	21.3	21.2	21.0	21.4	21.1	21.7	65.038
4.4	22.2	21.7	22.1	22.0	21.6	21.7	21.6	21.7	21.1	20.9	21.2	21.2	21.3	21.3	20.8	21.4	66.624
5.4	22.2	21.7	21.8	22.0	21.7	21.7	21.6	21.7	21.0	21.1	21.2	21.2	21.1	21.3	20.9	21.5	68.229
6.4	22.1	21.8	21.1	21.8	21.7	21.7	21.6	21.8	21.1	21.0	21.2	21.1	20.9	21.4	21.1	21.6	69.819
7.4	22.2	21.7	21.2	22.0	21.6	21.6	21.5	21.8	21.2	20.8	21.1	20.9	21.1	20.8	21.1	21.4	71.378
8.4	22.1	21.6	21.4	21.9	21.6	21.6	21.6	21.7	21.1	21.1	21.2	21.1	20.9	20.7	21.1	21.6	72.932
9.4	22.2	21.7	21.4	21.9	21.6	21.6	21.5	21.6	21.1	21.0	21.1	21.2	21.1	20.8	21.2	21.4	74.543
10.4	22.2	21.8	21.1	22.0	21.6	21.4	21.7	21.7	21.2	21.1	21.3	21.1	21.0	20.9	20.9	21.5	76.100
11.4	22.3	22.0	22.4	22.3	21.9	22.0	21.7	22.2	21.6	21.3	21.4	21.1	21.1	20.6	21.0	21.4	77.663
12.4	22.6	22.3	22.4	22.6	22.4	22.2	22.3	22.6	22.0	21.9	21.6	21.3	21.0	20.4	20.9	21.3	79.260
13.4	23.0	22.6	22.3	23.0	22.8	22.7	22.8	23.0	22.4	22.1	21.9	21.5	21.1	20.4	21.0	21.3	80.856
14.4	23.3	23.0	24.0	23.4	23.2	23.3	23.2	23.4	22.8	22.6	22.1	21.5	21.2	20.5	20.9	21.4	82.414
15.4	23.7	23.5	23.7	23.9	23.7	23.7	23.6	24.0	23.3	22.6	22.3	21.6	21.4	20.7	20.9	21.3	84.004
16.4	24.1	23.8	24.2	24.3	24.1	24.1	24.0	24.4	23.6	23.2	22.5	21.8	21.5	20.3	20.8	21.3	85.606
17.4	24.5	24.3	24.8	24.6	24.5	24.6	24.5	24.8	23.8	23.4	22.7	22.1	21.6	20.5	21.0	21.2	87.187
18.4	24.8	24.6	24.7	24.9	24.7	24.9	24.8	25.0	24.2	23.8	23.1	22.2	21.7	20.6	20.7	21.3	88.744
19.4	25.2	25.0	25.7	25.3	25.2	25.2	25.0	25.3	24.4	23.9	23.5	22.5	21.8	20.8	20.8	21.3	90.370
20.4	25.5	25.4	25.5	25.7	25.4	25.6	25.5	25.6	24.6	24.3	23.5	22.7	22.0	20.7	21.1	21.1	91.916
21.4	25.8	25.7	25.8	26.0	25.8	25.9	25.6	25.8	24.9	24.4	23.6	22.9	22.1	20.8	20.8	21.2	93.515
22.4	26.0	26.0	25.7	26.3	26.0	26.2	26.0	26.3	25.1	24.7	23.7	23.0	22.3	21.0	21.1	21.3	95.117
23.4	26.3	26.1	26.7	26.6	26.4	26.4	26.3	26.4	25.5	25.0	24.2	23.1	22.4	21.1	20.7	21.3	96.707
24.4	26.5	26.5	26.2	26.8	26.6	26.7	26.6	26.9	25.7	25.1	24.3	23.3	22.7	21.3	20.9	21.5	98.263
25.4	26.8	27.0	27.5	27.2	26.9	27.1	26.8	27.0	25.8	25.3	24.5	23.6	22.8	21.5	21.0	21.3	99.855
26.4	27.1	27.0	27.1	27.3	27.1	27.3	27.0	27.1	26.2	25.3	24.8	23.8	22.9	21.3	21.1	21.3	101.437
27.4	27.1	27.3	27.4	27.6	27.4	27.6	27.2	27.5	26.3	25.6	24.8	23.8	23.0	21.8	20.8	21.5	103.001
28.4	27.5	27.6	28.3	27.8	27.6	27.7	27.4	27.7	26.6	25.9	25.0	24.0	23.3	21.6	20.8	21.3	104.587
29.4	27.7	27.9	28.3	27.9	27.8	28.0	27.7	27.8	26.6	25.9	25.1	24.1	23.2	21.8	21.2	21.5	106.185
30.4	28.0	28.0	28.1	28.3	28.0	28.1	28.0	27.9	26.9	26.2	25.3	24.2	23.3	21.9	20.9	21.2	107.750
31.4	28.1	28.2	28.3	28.4	28.2	28.5	28.0	28.1	27.1	26.5	25.3	24.3	23.6	21.9	20.8	21.2	109.334
32.4	28.4	28.3	28.5	28.6	28.4	28.6	28.3	28.3	27.1	26.5	25.7	24.5	23.6	22.0	20.9	21.4	110.938
33.4	28.5	28.5	28.0	28.7	28.6	28.6	28.3	28.4	27.2	26.8	25.6	24.4	23.9	21.9	20.9	21.4	112.518
34.4	28.5	28.8	28.4	28.9	28.7	28.9	28.6	28.6	27.5	26.8	25.6	24.7	23.8	21.8	20.8	21.5	114.058
35.4	28.6	28.8	29.1	29.1	28.9	29.0	28.8	28.7	27.8	26.7	25.3	24.9	24.0	22.1	20.9	21.5	115.642
36.4	28.8	28.9	29.0	29.1	29.0	29.1	28.9	28.8	27.7	27.1	25.7	25.0	23.9	22.1	20.8	21.4	117.199
37.4	28.8	29.1	29.6	29.3	29.2	29.2	28.8	28.9	27.9	27.1	26.1	24.9	24.1	22.4	20.7	21.2	118.733
38.4	29.3	29.2	29.4	29.6	29.3	29.5	29.1	29.2	28.1	27.1	26.1	25.1	24.3	22.4	21.0	21.3	120.286
39.4	29.3	29.4	29.5	29.7	29.5	29.4	29.2	29.3	28.0	27.2	26.1	25.1	24.2	22.6	21.0	21.5	121.840
40.4	29.5	29.5	29.7	29.8	29.5	29.7	29.5	29.5	28.1	27.5	26.3	25.2	24.2	22.4	20.8	21.3	123.374
41.4	29.5	29.7	29.5	29.8	29.7	29.7	29.4	29.4	28.5	27.5	26.6	25.2	24.3	22.7	20.7	21.3	124.930

42.4	29.6	29.8	30.1	30.0	29.9	29.9	29.5	29.6	28.4	27.5	26.5	25.3	24.3	22.5	20.9	21.4	126.472
43.4	29.8	29.9	29.8	30.1	30.0	30.0	29.7	29.7	28.4	27.7	26.6	25.5	24.3	22.5	20.9	21.4	128.042
44.4	29.9	30.0	[illegible]	30.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26.7	25.5	24.8	22.7	20.8	21.5	129.564
45.4	29.9	30.0	29.6	30.4	30.1	30.3	29.9	29.8	28.6	27.8	26.6	25.5	24.5	23.0	21.0	21.5	131.200
46.4	30.0	30.2	30.2	30.4	30.1	30.2	29.9	29.9	28.7	27.9	26.8	25.7	24.5	22.6	21.1	21.5	132.812
47.4	30.1	30.3	30.2	30.5	30.2	30.3	30.0	30.2	28.8	28.0	26.9	25.8	24.7	22.7	21.2	21.2	134.379
48.4	30.0	30.4	30.8	30.4	30.3	30.4	30.1	30.2	28.9	28.0	26.8	25.5	24.8	22.8	21.1	21.7	135.947
49.4	30.0	30.4	30.4	30.5	30.4	30.5	30.0	30.1	28.8	28.0	26.9	25.7	24.7	22.8	20.9	21.4	137.510
50.4	30.3	30.5	30.7	30.6	30.4	30.6	30.0	30.3	29.1	28.3	27.0	25.9	24.8	22.8	20.9	21.5	139.044
51.4	30.4	30.6	30.7	30.9	30.7	30.8	30.3	30.3	29.2	28.3	27.1	26.0	25.1	23.2	20.9	21.3	140.600
52.4	30.3	30.6	30.7	30.8	30.7	30.7	30.6	30.6	29.0	28.3	27.1	26.0	25.1	23.0	20.9	21.3	142.136
53.4	30.5	30.6	30.8	30.9	30.7	30.8	30.5	30.6	29.2	28.3	27.3	26.0	25.1	23.1	21.0	21.6	143.698
54.4	30.5	30.8	30.7	31.0	30.8	30.9	30.7	30.7	29.3	28.4	27.3	26.1	25.1	23.3	20.9	21.4	145.220
55.4	30.8	30.9	30.5	31.2	31.0	30.9	30.6	30.7	29.6	28.7	27.7	26.2	25.2	23.4	21.0	21.5	146.775
56.4	31.1	30.9	30.6	31.4	31.2	31.3	30.8	30.6	29.6	28.6	27.6	26.4	25.5	23.5	21.1	21.3	148.316
57.4	30.9	30.9	30.8	31.4	31.3	31.2	30.9	31.0	29.6	28.7	27.4	26.3	25.5	23.5	21.0	21.4	149.837
58.4	30.9	31.2	31.1	31.4	31.1	31.2	30.9	31.0	29.6	28.8	27.7	26.5	25.5	23.4	21.0	21.7	151.390
59.4	31.1	31.2	30.8	31.6	31.3	31.3	31.0	31.0	29.9	28.8	27.8	26.4	25.5	23.3	21.1	21.4	152.922
60.4	30.9	31.1	31.2	31.3	31.0	31.2	30.8	30.9	29.6	28.6	27.7	26.3	25.3	23.2	21.1	21.5	154.439
61.4	31.1	31.4	31.6	31.6	31.3	31.5	31.2	31.1	29.6	28.7	27.8	26.4	25.6	23.6	21.0	21.5	155.982
62.4	31.3	31.4	32.2	31.4	31.3	31.6	31.0	31.2	29.8	29.0	27.8	26.6	25.5	23.4	21.2	21.7	157.510
63.4	31.3	31.6	31.6	31.7	31.4	31.5	31.1	31.2	29.9	29.0	27.8	26.4	25.6	23.2	21.0	21.4	159.032
64.4	31.3	31.5	31.7	31.7	31.5	31.6	31.3	31.4	29.9	29.2	27.9	26.4	25.5	23.6	21.1	21.6	160.548
65.4	31.3	31.6	31.2	31.4	31.3	31.6	31.2	31.2	29.9	29.1	28.0	26.5	25.5	23.5	21.2	21.4	162.079
66.4	31.3	31.6	31.2	31.4	31.3	31.7	31.2	31.2	29.9	28.9	27.8	26.7	25.7	23.7	21.1	21.6	163.588
67.4	31.3	31.8	31.1	31.4	31.3	31.7	31.2	31.5	29.9	29.0	28.0	26.7	25.7	23.7	21.0	21.5	165.113
68.4	31.3	31.7	31.6	31.2	31.1	31.6	31.3	31.4	30.0	29.2	27.9	26.6	25.6	23.5	21.0	21.5	166.652
69.4	31.6	31.8	31.3	31.4	31.1	31.6	31.3	31.2	30.0	29.0	27.8	26.7	25.8	23.7	21.2	21.3	168.212
70.4	31.6	31.8	31.4	31.4	31.3	31.8	31.3	31.5	30.0	29.0	27.9	26.7	25.7	23.8	21.2	21.5	169.747
71.4	31.4	31.8	31.6	31.5	31.3	31.7	31.3	31.5	30.0	29.4	28.0	26.9	25.7	23.8	21.1	21.5	171.323
72.4	31.5	31.8	31.1	31.4	31.3	31.9	31.5	31.5	30.1	29.1	28.0	26.7	25.7	23.6	21.4	21.6	172.887
73.4	31.4	31.8	31.6	31.5	31.3	31.7	31.4	31.4	30.0	29.1	28.0	26.7	25.8	23.7	21.3	21.5	174.457
74.4	31.6	31.9	31.4	31.4	31.3	31.8	31.2	31.5	30.0	29.2	27.9	26.6	25.7	23.7	21.3	21.4	176.005
75.4	31.6	31.8	31.2	31.6	31.3	31.8	31.5	31.5	30.0	29.1	27.9	26.9	25.7	23.7	21.3	21.4	1.537
76.4	31.6	31.8	31.3	31.4	31.3	31.8	31.5	31.5	30.0	29.4	28.3	26.7	25.8	23.6	21.1	21.6	3.121
77.4	31.5	31.8	31.0	31.4	31.3	31.8	31.5	31.5	30.1	29.2	28.1	26.7	25.7	23.7	21.2	21.5	4.675
78.4	31.5	31.8	31.6	31.6	31.4	31.8	31.4	31.5	30.3	29.3	27.9	26.7	25.7	23.9	21.2	21.4	6.243
79.4	31.6	31.9	32.1	31.6	31.5	31.9	31.5	31.5	30.2	29.2	28.1	26.8	26.0	23.7	21.1	21.4	7.844
80.4	31.6	31.8	31.3	31.4	31.3	31.7	31.5	31.5	30.1	29.2	28.1	26.7	25.8	23.7	21.3	21.2	9.405
81.4	31.3	31.8	31.5	31.4	31.3	31.8	31.4	31.5	30.3	28.9	27.9	26.7	25.8	23.9	21.1	21.4	10.992
82.4	31.6	31.8	31.6	31.6	31.5	32.0	31.5	31.5	30.2	29.3	28.1	26.8	25.8	23.9	21.3	21.5	12.591
83.4	31.6	31.9	31.4	31.4	31.2	31.9	31.5	31.6	30.3	29.3	28.1	26.9	25.9	23.9	21.3	21.3	14.167
84.4	31.4	31.8	31.9	31.4	31.4	31.8	31.4	31.5	30.1	29.2	28.0	26.9	25.8	23.8	21.1	21.3	15.748
85.4	31.6	31.8	31.3	31.4	31.1	31.8	31.5	31.5	30.0	29.2	28.0	26.7	25.6	23.7	21.3	21.5	17.330
86.4	31.5	31.8	31.8	31.5	31.3	31.7	31.3	31.5	29.9	29.2	28.4	26.9	26.0	23.8	21.3	21.5	18.912
87.4	31.6	31.9	31.3	31.5	31.2	31.8	31.5	31.5	30.2	29.4	28.1	27.0	25.7	23.8	21.3	21.6	20.461
88.4	31.7	31.9	30.7	31.5	31.3	31.8	31.4	31.6	30.1	29.2	28.1	26.9	26.0	23.9	21.2	21.4	22.057
89.4	31.6	31.8	31.3	31.4	31.1	31.7	31.2	31.5	30.1	29.5	28.1	26.9	25.9	24.1	21.3	21.5	23.636
90.4	31.6	31.8	31.6	31.4	31.2	31.8	31.3	31.4	30.1	29.3	28.0	26.7	26.0	24.0	21.3	21.4	25.214
91.4	31.6	31.8	30.8	31.5	31.3	31.7	31.2	31.2	30.0	29.2	28.2	26.9	25.9	23.8	21.2	21.3	26.800

92.4	31.6	31.8	31.1	31.5	31.3	31.8	31.4	31.3	30.2	29.1	28.1	26.9	25.9	23.9	21.5	21.4	28.399
93.4	31.6	31.9	30.3	31.5	31.4	31.8	31.3	31.5	30.2	29.4	28.2	27.0	25.8	23.9	21.4	21.5	29.972
94.4	31.5	31.8	30.5	31.6	31.3	31.7	31.3	31.5	30.0	29.0	28.1	26.9	25.9	24.2	21.5	21.6	31.551
95.4	31.4	31.8	31.8	31.6	31.3	31.8	31.2	31.5	30.1	29.2	28.1	26.9	25.8	24.1	21.3	21.3	33.129
96.5	31.6	31.7	32.0	31.4	31.3	31.8	31.3	31.4	30.1	29.3	28.2	26.7	25.7	23.9	21.4	21.4	34.707
97.5	31.7	32.0	31.5	31.5	31.4	31.9	31.6	31.5	30.2	29.3	28.2	27.0	25.8	24.1	21.4	21.6	36.270
98.5	31.5	31.9	31.0	31.6	31.3	31.8	31.5	31.4	30.1	29.3	28.0	26.7	25.9	24.0	21.4	21.4	37.829
99.5	31.5	31.8	30.5	31.7	31.3	31.8	31.5	31.5	30.1	29.3	27.8	26.8	25.8	24.0	21.5	21.4	39.379
100.5	31.6	31.8	31.3	31.6	31.3	31.8	31.6	31.4	30.1	29.4	28.3	27.0	25.7	23.7	21.3	21.4	40.927
101.5	31.4	31.8	31.9	31.5	30.6	31.7	31.5	31.5	30.1	29.3	28.0	26.8	25.8	23.8	21.3	21.3	42.471
102.5	31.6	31.8	31.3	31.6	31.3	31.9	31.4	31.5	30.0	29.2	28.0	26.8	26.0	24.0	21.3	21.5	43.999
103.5	31.4	31.8	30.7	31.1	31.3	31.8	31.5	31.5	29.9	29.3	28.1	26.9	26.0	24.0	21.4	21.5	45.528
104.5	31.7	31.9	31.3	31.7	30.9	31.9	31.5	31.5	30.2	29.4	28.3	27.0	26.0	24.0	21.4	21.4	47.015
105.5	31.7	32.0	31.2	30.9	31.2	31.9	31.4	31.6	30.3	29.3	28.2	27.0	25.8	24.0	21.7	21.6	48.581
106.5	31.7	32.0	31.4	31.6	31.3	32.0	31.6	31.5	30.2	29.3	28.1	27.1	26.1	24.1	21.5	21.7	50.122
107.5	31.6	31.9	31.6	31.6	31.2	31.7	31.4	31.5	30.2	29.3	28.0	27.0	26.1	23.8	21.4	21.6	51.636
108.5	31.5	31.9	31.4	31.5	31.2	31.9	31.6	31.6	30.1	29.5	28.4	26.9	26.0	24.0	21.6	21.6	53.172
109.5	31.7	31.8	30.8	31.5	31.3	31.8	31.5	31.4	30.2	29.2	28.1	27.0	26.0	24.0	21.3	21.4	54.722
110.5	31.6	31.9	31.4	31.6	31.4	31.9	31.6	31.6	30.1	29.5	28.2	27.0	26.0	24.2	21.5	21.7	56.243
111.5	31.5	31.9	31.2	31.5	31.2	31.8	31.4	31.5	30.0	29.2	28.1	27.1	26.0	24.2	21.7	21.5	57.797
112.5	31.3	31.9	31.2	31.5	31.2	31.6	31.3	31.5	30.2	29.3	28.2	27.0	26.0	24.1	21.7	21.3	59.350
113.5	31.5	31.9	31.3	31.5	31.2	31.8	31.6	31.6	30.2	29.6	28.3	27.1	26.2	24.1	21.5	21.4	60.903
114.5	31.4	31.9	30.4	31.5	31.1	31.7	31.5	31.5	30.2	29.4	28.0	27.0	26.0	23.9	21.6	21.6	62.411
115.5	31.5	31.9	31.2	31.5	31.3	31.8	31.3	31.6	30.3	29.5	28.2	27.0	26.0	24.2	21.5	21.4	63.956
116.5	31.2	31.6	31.6	31.2	31.1	31.6	31.2	31.3	30.2	29.3	28.0	26.7	25.9	24.0	21.5	21.4	65.495
117.5	31.6	31.9	31.1	31.5	31.3	31.9	31.5	31.4	30.2	29.4	28.2	26.9	25.9	24.2	21.6	21.5	67.015
118.5	31.5	31.7	31.2	31.5	31.2	31.8	31.5	31.5	30.2	29.6	28.4	27.0	26.0	24.2	21.5	21.5	68.563
119.5	31.7	31.9	31.1	31.5	31.3	31.7	31.5	31.6	30.3	29.3	28.1	27.0	25.9	24.3	21.5	21.6	70.106
124.0	31.3	31.8	31.2	31.3	31.2	31.6	31.3	31.4	30.2	29.4	28.2	26.8	26.0	24.2	21.6	21.3	76.800
124.4	31.4	31.7	31.2	31.5	31.1	31.7	31.3	31.3	30.1	29.3	28.4	27.1	25.9	24.1	21.7	21.7	77.365
125.4	31.6	31.9	31.2	31.4	31.2	31.7	31.4	31.5	30.1	29.3	28.0	26.8	26.1	24.2	21.8	21.5	78.872
126.4	31.4	31.7	31.2	31.3	31.2	31.8	31.4	31.6	30.0	29.4	28.2	26.9	26.0	24.4	21.7	21.6	80.382
127.4	31.3	31.7	31.4	31.3	31.2	31.9	31.3	31.4	30.0	29.3	28.0	26.8	26.1	24.0	21.7	21.6	81.874
128.4	31.6	31.9	31.7	31.5	31.2	31.8	31.6	31.3	30.2	29.2	28.2	26.9	25.9	23.9	21.7	21.6	83.355
129.4	31.5	31.9	30.5	31.5	31.2	31.6	31.3	31.4	30.2	29.3	27.9	26.8	25.8	24.2	21.7	21.5	84.839
130.4	31.4	31.9	31.7	31.5	31.2	31.9	31.4	31.4	30.1	29.2	27.9	26.8	25.9	24.1	21.8	21.5	86.346
131.4	31.4	31.7	31.1	31.2	31.2	31.9	31.3	31.4	30.2	29.3	28.0	26.8	26.1	24.2	21.5	21.5	87.841
132.4	31.4	31.7	31.0	31.3	31.2	31.7	31.2	31.5	30.1	29.3	28.2	26.9	25.8	23.8	21.7	21.4	89.331
133.4	31.4	31.8	30.9	31.3	31.2	31.6	31.3	31.4	30.1	29.3	28.1	26.8	25.8	24.1	21.9	21.5	90.858
134.4	31.4	31.6	31.4	31.5	31.2	31.7	31.3	31.5	30.2	29.3	27.9	27.0	26.0	24.0	21.5	21.5	92.373
135.4	31.4	31.8	31.9	31.5	31.2	31.7	31.3	31.6	30.2	29.3	28.1	27.0	25.8	24.1	21.6	21.7	93.855
136.4	31.4	31.7	30.9	31.5	31.2	31.9	31.4	31.6	30.2	29.3	28.0	26.9	26.0	24.0	21.7	21.4	95.373
137.4	31.7	31.9	31.0	31.5	31.2	31.7	31.6	31.6	30.2	29.3	28.2	26.8	25.9	24.2	21.7	21.4	96.896
138.4	31.5	31.7	31.2	31.4	31.2	31.8	31.3	31.3	30.0	29.0	28.2	26.8	25.8	24.1	21.7	21.4	98.398
139.4	31.3	31.4	30.9	31.1	30.9	31.4	31.1	31.0	29.7	28.7	27.7	26.8	25.8	24.0	21.7	21.7	99.898
140.4	30.8	31.0	30.3	30.5	30.3	30.8	30.5	30.5	29.2	28.2	27.3	26.7	25.8	24.0	21.6	21.5	101.395
141.4	30.5	30.7	30.1	30.2	30.0	30.5	30.2	30.0	28.9	28.0	27.4	26.5	25.8	23.8	21.7	21.4	102.876
142.4	30.3	30.3	30.0	29.9	29.7	29.9	29.5	29.6	28.5	27.9	27.1	26.3	25.7	24.1	21.6	21.4	104.362
143.4	30.0	30.0	29.5	29.8	29.2	29.5	29.4	29.2	28.1	27.5	27.0	26.2	25.6	23.9	21.7	21.3	105.885
144.4	29.6	29.6	29.0	29.2	28.9	29.2	28.8	28.8	27.7	27.1	26.7	25.9	25.3	23.7	21.8	21.4	107.392

145.4	29.2	29.3	28.9	29.0	28.7	29.0	28.6	28.5	27.7	27.0	26.3	25.8	25.2	23.8	21.7	21.5	108.890
146.4	28.8	28.9	28.6	28.5	28.2	28.5	28.1	28.3	27.2	26.7	26.1	25.6	25.0	23.5	21.8	21.4	110.395
147.4	28.6	28.6	28.2	28.3	27.8	28.2	27.9	28.0	27.0	26.4	26.1	25.6	24.9	23.5	21.7	21.4	111.903
148.4	28.3	28.3	27.8	27.9	27.6	28.1	27.7	27.6	26.7	26.3	25.7	25.4	24.9	23.5	22.0	21.5	113.385
149.4	28.1	27.9	27.8	27.7	27.3	27.8	27.2	27.5	26.6	26.0	25.4	25.2	24.7	23.6	21.7	21.4	114.898
150.4	27.8	27.7	27.4	27.4	27.0	27.4	27.2	27.3	26.3	25.7	25.4	25.1	24.6	23.1	21.7	21.4	116.416
151.4	27.5	27.5	27.7	27.2	27.0	27.1	26.9	27.0	26.2	25.6	25.4	24.9	24.5	23.2	21.7	21.5	117.911
152.4	28.1	28.2	26.6	27.9	27.4	27.7	27.8	28.2	27.4	27.3	26.1	24.9	24.4	23.1	21.7	21.4	119.441
153.4	29.4	29.9	29.5	29.7	29.4	29.9	30.1	30.8	30.0	29.8	27.9	25.5	24.5	23.2	21.8	21.5	120.963
153.8	30.2	30.6	30.5	30.5	30.3	30.9	31.0	31.7	31.2	30.6	28.5	25.8	24.7	23.1	21.8	21.5	121.553
154.8	31.7	32.5	34.5	32.7	32.5	33.2	33.1	34.3	33.3	32.6	29.6	26.8	25.3	23.0	21.6	21.4	123.035
155.2	32.6	33.4	32.3	33.6	33.4	34.2	34.3	35.1	34.1	33.2	30.4	27.3	25.5	23.6	21.9	21.4	123.624
156.2	34.7	35.4	34.2	35.4	35.4	36.5	36.5	37.6	36.1	35.2	32.0	28.3	26.1	23.6	21.7	21.6	125.116
156.6	35.3	36.3	38.5	36.4	36.7	37.7	37.5	38.3	37.0	35.8	32.1	28.7	26.4	24.0	21.7	21.4	0.987
157.6	37.2	38.6	36.6	38.8	38.8	40.0	39.7	40.4	38.9	37.6	33.6	29.6	27.0	24.2	21.9	21.5	2.395
158.0	37.9	39.3	37.7	39.4	39.7	40.8	40.5	41.4	39.6	37.9	34.0	30.0	27.4	24.4	21.7	21.5	2.993
159.0	40.0	41.4	39.0	40.8	41.1	43.1	42.9	43.4	41.3	39.7	35.3	30.9	27.9	24.7	21.9	21.6	4.533
159.3	40.7	42.1	40.0	42.0	42.0	43.9	43.4	44.1	42.0	40.5	35.6	31.1	28.2	25.3	21.8	21.5	5.133
160.3	42.5	44.2	44.2	44.2	44.7	45.9	45.4	46.1	43.5	41.6	36.5	32.2	28.9	25.3	21.8	21.6	6.667
160.7	43.2	45.1	43.2	44.8	45.2	46.8	46.1	46.6	44.2	42.2	37.3	32.7	29.5	25.6	22.0	21.3	7.266
161.7	45.2	47.2	45.3	46.7	46.8	48.5	47.6	48.4	45.9	43.5	38.3	33.6	30.3	26.1	21.7	21.4	8.835
162.1	45.8	47.7	48.0	47.7	47.8	49.3	48.8	49.1	46.4	43.9	38.9	34.0	30.5	26.4	21.9	21.5	9.444
163.1	47.1	49.4	46.7	49.2	49.1	50.9	50.4	50.7	47.7	45.3	39.7	34.9	31.1	26.8	21.8	21.3	10.999
163.5	47.6	50.0	46.0	49.8	50.2	51.6	51.0	51.1	48.5	45.8	40.3	35.1	31.3	26.9	21.7	21.4	11.605
164.5	49.6	51.7	48.8	51.2	51.1	53.0	52.2	52.8	49.5	46.8	41.1	36.1	32.1	27.8	21.8	21.6	13.208
164.9	49.9	52.4	54.1	51.8	51.9	53.8	52.9	53.1	50.0	47.4	41.8	36.2	32.2	27.9	21.8	21.4	13.816
165.9	51.4	53.9	54.2	53.2	53.0	54.9	54.4	54.6	51.1	48.4	43.0	37.1	32.8	28.1	21.9	21.4	15.387
166.3	51.7	54.1	53.8	53.4	54.0	55.5	54.9	54.9	51.5	48.7	42.9	37.3	33.1	28.2	21.8	21.5	16.005
167.3	53.2	55.7	52.5	54.7	55.1	56.9	56.1	56.3	53.1	50.1	43.9	38.0	33.7	28.7	21.9	21.4	17.593
167.7	53.6	56.4	59.2	55.7	56.2	57.8	56.9	56.5	53.3	50.2	44.1	38.4	34.0	29.4	21.9	21.4	18.213
168.7	54.9	57.6	53.7	56.7	56.9	58.6	57.6	57.8	54.4	51.1	44.4	39.2	34.7	29.5	21.8	21.4	19.769
169.1	55.1	58.1	58.2	56.9	56.9	59.1	58.1	58.4	54.5	51.4	45.1	39.3	34.8	29.9	21.9	21.5	20.383
170.1	56.7	59.5	58.7	58.3	58.5	60.5	59.2	59.2	55.4	52.3	46.0	40.2	35.4	30.3	21.7	21.4	21.969
170.4	57.7	59.8	58.9	59.3	59.3	61.0	59.9	59.9	56.0	52.9	46.3	40.2	35.7	30.2	21.9	21.6	22.582
171.4	57.8	60.6	56.6	59.2	59.7	61.7	60.4	60.7	56.7	53.3	46.6	40.7	36.2	30.5	21.8	21.4	24.122
172.4	59.0	61.7	57.1	60.9	61.0	62.7	61.8	61.7	57.6	54.1	47.8	41.5	36.8	31.3	22.0	21.6	25.693
172.8	59.6	62.3	56.3	61.1	61.6	63.3	62.2	62.0	57.8	55.0	48.0	41.9	37.0	31.4	21.8	21.6	26.323
173.8	60.4	63.4	60.6	61.7	62.4	64.3	63.5	63.0	58.7	55.4	48.6	42.4	37.3	31.6	22.0	21.5	27.859
174.8	61.0	63.8	55.4	62.1	62.3	64.9	63.7	63.9	59.4	56.1	49.0	43.0	37.8	31.7	22.0	21.5	29.424
175.8	61.4	64.7	63.2	63.6	63.8	65.6	64.5	64.6	60.4	56.7	49.3	43.4	38.6	32.4	21.7	21.3	30.978
176.8	62.2	65.4	61.8	63.6	63.8	66.0	65.2	65.1	61.0	57.4	50.0	43.8	38.9	32.6	22.0	21.4	32.513
177.8	62.8	66.1	64.5	64.0	64.0	67.0	65.8	66.0	61.5	57.8	50.4	44.1	39.1	32.9	21.8	21.5	34.061
178.8	63.9	66.8	66.6	64.9	65.2	67.8	66.7	66.7	62.2	58.9	51.1	44.9	39.8	33.3	22.0	21.6	35.579
179.2	64.2	67.3	62.9	65.5	65.8	67.7	66.9	66.8	62.4	58.4	51.6	44.9	39.8	33.7	22.0	21.5	36.194
180.2	64.7	68.0	61.8	66.2	66.3	68.4	67.3	67.3	63.0	59.2	51.4	45.4	40.2	33.7	21.9	21.5	37.708
181.2	65.5	68.7	67.3	66.6	67.1	69.3	68.8	68.0	63.2	59.5	52.4	45.8	40.6	34.4	22.0	21.8	39.218
182.2	66.3	69.1	67.1	67.2	67.0	69.5	68.9	68.6	64.0	60.0	52.8	46.3	40.9	34.6	22.0	21.6	40.740
183.2	66.3	69.3	67.7	67.6	67.7	70.0	69.2	69.2	64.3	60.5	53.1	46.6	41.1	35.1	22.0	21.7	42.216
184.2	66.7	70.0	66.4	67.3	67.6	70.4	69.6	69.7	65.1	61.4	53.7	46.9	41.4	35.1	22.1	21.6	43.768
185.2	66.9	70.5	66.5	68.9	68.7	71.2	69.7	70.0	65.5	61.7	53.7	47.3	42.1	36.0	22.1	21.7	45.291

186.2	67.4	71.1	64.8	68.5	68.9	71.3	70.4	70.5	66.0	62.1	54.0	47.8	42.2	36.1	22.3	21.5	46.807
187.2	68.0	71.4	66.6	69.2	69.0	71.7	70.7	71.0	66.1	62.2	54.8	48.1	42.7	36.3	22.4	21.6	48.332
188.2	68.0	71.6	68.7	69.1	69.5	71.8	71.0	71.4	66.8	62.6	54.7	48.1	42.8	36.4	22.4	21.4	49.855
189.2	68.9	72.3	69.0	70.2	70.3	72.6	71.2	71.3	66.6	63.0	54.9	48.5	43.1	36.2	22.5	21.5	51.361
190.2	68.8	72.2	67.7	69.6	69.9	72.6	71.5	71.7	67.1	63.3	55.4	48.9	43.3	36.6	22.4	21.5	52.841
191.2	69.3	72.7	68.7	71.0	70.6	73.2	72.3	71.9	67.1	63.3	55.2	49.1	43.8	36.5	22.6	21.7	54.297
192.2	69.5	73.1	70.3	71.9	72.4	74.0	73.2	72.6	68.3	64.3	56.2	49.3	44.0	37.4	22.6	21.9	55.788
193.2	69.6	73.4	68.7	71.6	72.1	73.8	72.6	72.7	68.1	64.0	55.9	49.5	44.1	36.9	22.4	21.5	57.236
194.2	70.0	73.5	69.4	71.2	71.3	74.0	73.0	72.6	68.2	64.1	56.1	49.6	44.3	37.8	22.6	21.5	58.703
195.2	69.9	73.6	71.1	71.2	71.4	74.2	73.3	73.3	68.6	64.8	56.9	50.1	44.6	38.2	22.6	21.6	60.201
196.2	70.3	73.9	70.9	71.4	71.3	73.9	73.0	73.5	69.1	65.0	56.8	50.1	44.9	37.8	22.6	21.4	61.674
197.2	70.3	74.2	71.0	71.8	72.0	74.5	73.6	73.7	68.9	65.1	56.9	50.4	45.0	38.0	22.9	21.9	63.161
198.2	70.3	74.4	72.2	72.1	72.4	74.9	73.6	74.0	68.8	65.2	57.3	50.7	45.1	37.7	22.9	21.7	64.653
199.2	71.0	74.6	72.2	72.9	73.0	75.3	74.3	74.1	69.5	65.7	57.7	51.0	45.3	38.7	23.0	21.7	66.115
200.2	71.5	75.1	71.4	72.8	72.8	75.3	73.9	74.3	68.9	65.5	57.8	51.1	45.6	38.3	23.0	21.6	67.617
201.2	70.8	74.9	70.7	72.3	73.3	75.7	74.5	74.4	69.4	65.7	57.3	51.0	45.9	38.5	22.9	21.5	69.108
202.2	71.5	75.3	72.4	72.6	73.3	75.5	74.3	74.7	69.8	65.5	57.9	51.2	45.7	38.7	23.2	21.7	70.607
203.2	70.7	75.2	70.9	72.6	72.8	75.6	74.7	74.8	69.5	65.9	57.5	51.2	45.9	38.4	23.1	21.9	72.073
204.2	71.3	75.5	71.3	72.7	73.3	76.0	74.5	74.9	70.1	66.4	58.2	51.2	46.0	38.7	23.0	21.5	73.548
205.2	71.3	75.3	70.7	72.6	72.6	75.7	74.3	74.8	70.3	66.4	57.8	51.4	46.3	38.8	23.2	21.4	75.034
206.2	71.3	75.5	72.1	72.9	72.6	76.1	74.6	75.2	69.9	65.9	57.8	51.5	46.4	39.3	23.2	21.6	76.476
207.2	71.5	75.7	71.5	73.6	73.9	75.9	74.8	75.0	69.8	66.1	57.8	51.5	46.3	39.0	23.2	21.6	77.956
208.2	71.1	75.5	71.5	72.5	73.0	76.3	74.7	75.2	70.2	66.3	58.0	51.9	46.4	38.9	23.4	21.3	79.413
209.2	72.6	76.1	71.4	73.4	73.7	76.3	75.2	75.1	70.3	66.9	58.3	51.9	46.6	39.4	23.4	21.5	80.840
209.6	72.0	75.7	70.8	72.7	73.1	76.1	74.7	75.5	70.5	66.6	58.3	52.0	46.6	39.6	23.5	21.6	81.428
210.6	71.7	76.0	71.8	73.1	72.8	76.0	74.9	75.9	70.7	66.8	58.7	52.0	46.9	39.0	23.5	21.7	82.881
211.6	71.7	75.7	73.?	73.3	73.5	76.3	75.2	75.9	70.9	66.9	58.4	52.1	46.6	38.7	23.7	21.7	84.345
212.6	71.7	75.8	73.1	73.6	73.5	76.6	75.6	75.6	71.2	67.2	58.9	52.2	47.0	39.8	23.6	21.6	85.791
213.6	72.0	76.0	72.6	74.0	73.7	76.4	75.4	76.0	70.9	67.0	58.7	52.1	46.9	39.5	23.8	21.5	87.212
214.6	72.1	76.3	72.6	74.4	74.2	76.7	75.7	75.5	70.9	67.6	59.8	52.4	47.1	39.9	23.6	21.6	88.668
215.6	72.0	76.1	74.2	74.0	73.8	76.7	75.2	75.9	71.4	67.5	59.5	52.7	47.2	40.1	23.6	21.7	90.113
216.6	72.4	76.5	72.8	74.2	74.1	76.4	75.8	75.8	70.9	67.5	59.3	52.3	47.1	39.7	23.6	21.6	91.515
217.6	72.5	76.4	71.9	74.2	73.7	76.7	75.4	76.3	71.4	67.2	58.4	52.4	47.2	39.5	23.7	21.5	92.955
218.6	73.4	76.9	71.5	74.8	75.1	77.5	76.3	76.4	71.0	67.8	59.4	52.6	47.4	39.9	24.0	21.5	94.346
219.6	73.1	76.8	72.8	74.0	74.5	77.1	76.7	76.3	71.0	67.9	59.9	52.7	47.4	39.7	23.8	21.7	95.697
220.6	72.9	76.8	72.9	74.9	75.2	77.6	76.5	76.6	71.6	68.1	60.1	52.9	47.4	40.0	24.1	21.6	97.033
221.6	73.4	77.2	73.7	75.1	75.6	77.4	76.4	76.4	71.6	67.7	59.6	52.8	47.2	39.9	24.1	21.7	98.373
222.6	72.9	76.9	74.4	74.9	75.7	77.8	76.9	76.4	71.7	67.4	59.3	52.9	48.0	40.0	24.2	21.8	99.721
223.6	72.6	76.8	73.0	74.5	74.3	77.3	75.7	76.4	71.2	67.4	60.0	53.1	47.7	40.2	24.1	21.7	101.031
224.6	72.1	76.8	73.0	74.6	74.9	77.1	76.0	76.4	71.9	68.0	59.8	53.0	47.8	40.2	24.1	21.5	102.371
225.6	73.1	77.1	73.7	74.2	73.9	77.1	76.0	76.6	71.3	67.4	59.6	52.8	47.6	40.1	24.2	21.7	103.692
226.0	72.8	76.8	71.1	73.4	73.4	76.9	75.5	76.5	71.6	67.5	59.9	52.9	47.7	39.7	24.3	21.7	104.203
227.0	73.4	77.0	74.0	75.1	75.2	77.7	76.3	76.6	71.6	67.8	59.6	52.9	47.7	40.0	24.4	21.7	105.557
228.0	72.8	76.9	72.4	75.0	75.9	77.7	76.9	76.6	71.4	68.0	60.2	52.9	47.6	40.1	24.5	21.4	106.892
229.0	73.1	77.3	73.0	74.5	74.5	77.1	75.8	76.6	71.4	67.3	59.3	52.9	47.9	40.0	24.3	21.6	108.230
230.0	73.0	77.0	74.3	74.5	74.3	77.3	75.9	76.8	71.4	67.9	59.6	52.9	47.8	40.2	24.7	21.7	109.500
231.0	73.2	77.3	73.7	74.5	74.5	77.5	76.3	76.9	71.8	67.8	59.4	52.9	48.0	39.8	24.6	21.7	110.751
232.0	73.4	77.3	72.7	74.9	74.6	77.2	76.0	76.7	71.7	67.4	59.2	52.7	48.0	40.2	24.7	21.8	112.004
233.0	74.0	77.7	73.7	75.2	75.1	77.8	76.5	76.5	71.4	67.6	59.9	53.3	48.2	40.4	24.8	21.8	113.248
234.0	73.4	77.4	74.6	74.8	74.9	77.5	76.3	76.9	71.8	68.4	60.4	53.4	48.1	40.8	24.8	21.8	114.531

235.0	73.8	77.4	74.2	74.9	75.1	77.7	76.7	77.1	72.1	68.0	60.4	53.2	48.1	40.5	24.8	21.8	115.835
236.0	73.6	77.8	72.7	75.4	76.1	78.0	77.2	77.3	72.4	68.2	60.4	53.4	48.2	40.2	24.8	21.8	117.120
237.0	73.2	77.4	73.5	74.5	74.9	78.1	76.9	76.9	72.2	68.4	60.4	53.6	48.4	40.3	25.0	21.8	118.421
238.0	73.5	77.2	75.3	76.2	75.7	78.2	77.3	77.3	72.6	68.3	60.3	53.4	48.4	40.7	25.0	21.8	119.753
239.0	73.8	78.1	74.8	74.8	74.2	77.9	76.7	77.1	72.6	68.3	60.1	53.7	48.6	40.5	25.1	21.6	121.062
240.0	73.8	78.2	74.0	75.4	75.1	77.9	77.1	77.4	72.3	68.4	60.6	53.9	48.6	40.8	25.1	21.8	122.367
241.0	73.8	77.9	74.2	75.2	75.1	77.9	77.1	77.4	72.4	68.8	61.0	53.9	48.6	41.3	25.1	21.9	123.696
242.0	73.5	77.4	74.2	75.8	76.3	78.8	77.4	77.9	72.1	68.7	61.3	53.8	48.7	40.7	25.1	21.8	125.059
243.0	74.0	78.0	74.8	75.9	76.5	78.9	77.3	77.4	72.1	68.5	60.9	53.9	48.7	40.7	25.1	21.8	126.341
244.0	74.3	78.0	74.4	76.1	76.8	79.0	77.6	77.3	72.8	68.8	61.2	54.2	48.7	41.3	25.1	21.7	127.688
245.0	73.5	77.8	73.5	75.4	74.9	78.4	76.7	77.7	72.6	68.8	60.8	53.9	48.9	40.8	25.1	21.7	129.018
246.0	74.3	78.1	73.6	75.4	75.7	78.5	77.3	77.7	72.4	68.1	60.5	53.9	48.9	40.8	25.3	21.8	130.350
247.0	73.2	76.9	73.1	74.7	74.7	77.8	76.4	76.1	70.2	65.8	59.2	53.6	48.9	40.7	25.2	21.5	131.671
247.4	72.4	76.1	73.1	74.7	74.9	77.4	76.2	75.0	69.9	65.8	59.2	53.4	48.7	41.3	25.4	21.7	132.169
248.4	71.0	74.2	70.2	71.1	71.3	74.5	72.7	72.5	66.9	62.5	56.6	52.3	48.1	40.7	25.4	21.8	133.480
248.8	70.8	73.5	69.7	71.5	71.9	74.1	72.4	71.3	66.3	62.2	56.3	52.0	48.1	41.0	25.4	21.5	133.993
249.8	68.9	71.8	68.1	69.2	69.1	71.3	69.4	69.1	64.2	60.4	55.3	51.3	47.6	40.4	25.5	21.6	135.292
250.2	67.6	70.6	66.7	68.2	68.8	70.6	69.0	68.2	63.0	59.8	55.2	51.1	47.2	40.4	25.6	21.9	135.812
250.6	67.0	69.8	66.7	67.5	67.3	69.6	68.4	67.1	62.5	59.4	55.0	50.6	47.0	40.4	25.6	21.7	136.321
251.6	64.7	67.5	64.9	64.7	64.0	66.4	65.4	64.7	60.1	57.0	53.0	49.7	46.2	40.2	25.5	21.8	137.651
252.0	64.4	66.6	63.4	64.1	63.5	66.0	64.3	63.8	59.7	56.5	52.7	49.4	46.1	39.6	25.4	21.7	138.158
253.0	62.1	64.6	61.5	61.9	61.4	63.5	61.6	61.6	57.6	54.9	51.1	48.3	45.5	39.7	25.5	21.8	139.436
253.4	60.6	63.5	60.2	60.6	60.0	62.6	60.9	60.7	56.8	54.4	50.9	48.0	45.4	39.4	25.6	21.8	139.938
253.8	60.7	62.9	60.1	60.3	60.0	61.9	60.2	60.1	56.2	53.5	50.3	47.6	45.1	39.1	25.6	21.9	140.452
254.8	58.6	61.0	57.4	58.4	58.1	60.1	58.8	58.4	54.6	52.5	49.0	46.7	44.3	38.7	25.7	21.7	141.731
255.1	58.1	60.2	57.4	58.0	57.0	59.0	57.7	57.6	54.0	51.7	48.8	46.3	43.9	38.2	25.6	21.6	142.206
256.1	56.2	58.4	55.4	55.6	55.0	57.0	55.5	55.8	52.2	50.6	47.8	45.5	43.1	38.0	25.6	21.7	143.462
256.5	55.2	57.5	54.6	55.4	55.2	56.5	55.3	54.9	51.8	50.0	47.2	45.1	43.2	37.9	25.5	21.8	143.933
256.9	54.9	57.0	54.1	55.0	54.3	55.8	54.6	54.3	51.3	49.7	47.0	44.7	42.6	37.9	25.8	21.7	144.423
257.9	53.2	55.1	52.7	53.2	52.6	54.0	52.9	52.7	50.1	48.1	45.6	43.7	42.1	37.6	25.6	21.8	145.672
258.3	52.3	54.5	51.9	52.1	51.5	53.2	52.3	52.2	49.4	47.7	45.4	43.5	41.8	36.7	25.7	21 9	146.166
259.3	51.2	52.8	50.3	50.9	50.7	52.1	51.0	50.9	48.2	46.5	44.4	42.7	41.1	36.4	25.6	21.6	147.401
259.7	50.5	52.1	49.9	50.4	50.3	51.5	50.6	50.3	47.7	46.4	43.9	42.2	40.9	36.5	25.8	21.9	147.854
260.7	49.4	50.9	48.8	49.2	49.0	50.2	49.2	49.1	46.4	45.2	43.1	41.4	40.2	35.9	25.8	21.6	149.120
261.1	48.5	50.1	47.8	48.1	47.7	49.2	48.2	48.3	46.0	44.5	42.6	41.3	39.9	35.2	25.8	21.6	149.592
262.1	47.4	48.9	46.9	47.2	46.8	48.0	47.0	47.1	45.0	43.8	41.8	40.5	39.3	35.5	26.0	21.6	150.796
262.5	47.2	48.6	46.7	46.7	46.4	47.5	46.7	46.8	44.7	43.3	41.5	40.2	39.1	35.1	25.9	21.7	151.279
263.5	45.9	47.2	45.4	45.7	45.0	46.6	45.4	45.8	43.6	42.3	40.7	39.6	38.5	34.8	26.1	22.0	152.507
263.9	45.0	46.5	44.5	45.1	44.4	45.7	45.0	45.2	43.2	42.0	40.4	39.4	38.3	34.4	25.9	21.7	152.986
264.9	44.1	45.5	44.0	44.1	43.6	44.8	44.2	44.4	42.1	40.9	39.6	38.7	37.7	34.2	25.9	21.6	154.206
265.9	43.6	44.6	42.9	43.3	42.9	44.0	43.1	43.1	41.2	40.4	38.9	38.0	37.2	33.9	25.9	21.6	155.430
266.9	42.5	43.4	41.7	42.1	41.5	42.7	42.1	42.2	40.6	39.4	38.4	37.5	36.7	33.3	25.8	21.8	156.682
267.2	42.1	43.0	41.4	41.5	41.1	42.4	41.5	42.0	39.9	39.2	37.9	37.2	36.3	33.5	26.2	21.8	157.158
268.2	41.2	42.2	40.7	40.9	40.6	41.5	40.7	41.1	39.4	38.5	37.4	36.5	36.0	33.2	25.9	21.6	158.389
269.2	40.3	41.2	40.0	39.7	39.5	40.6	39.9	40.2	38.5	37.9	36.8	36.3	35.7	32.8	26.0	21.5	159.634
270.2	39.4	40.2	38.9	39.0	38.6	39.7	39.3	39.3	37.9	37.1	36.1	35.5	34.7	32.3	25.9	21.7	160.874
271.2	38.9	39.4	37.8	38.6	38.3	38.8	38.6	38.6	37.2	36.5	35.5	35.0	34.3	31.7	26.2	21.8	162.109
272.2	38.1	38.7	37.4	37.9	37.1	38.1	37.6	37.9	36.5	35.8	35.1	34.7	34.2	31.8	26.0	21.8	163.367
273.2	37.4	38.0	37.0	36.8	36.6	37.7	37.1	37.3	35.9	35.3	34.6	34.2	33.6	30.9	26.1	21.6	164.622
274.2	36.7	37.2	36.0	36.1	35.8	36.8	36.3	36.7	35.3	34.9	34.1	33.6	33.0	31.1	26.2	21.7	165.860

275.2	35.9	36.6	35.5	35.7	35.3	36.1	35.6	36.1	34.8	34.1	33.5	33.1	32.8	30.6	26.1	21.5	167.117
276.2	35.4	35.9	34.8	35.1	34.5	35.5	35.2	35.5	34.3	33.7	33.3	32.6	32.5	30.3	25.9	21.5	168.382
277.3	34.8	35.2	34.6	34.8	34.4	35.0	34.6	35.0	33.6	33.2	32.6	32.0	32.1	30.4	25.9	21.5	169.657
278.3	34.5	35.0	34.0	34.0	33.5	34.7	34.3	34.6	33.3	33.0	32.5	31.6	31.8	30.0	26.2	21.5	170.900
279.3	34.9	35.8	36.2	35.1	34.5	35.5	35.5	36.3	35.6	35.1	33.5	31.7	31.4	28.9	26.0	21.5	172.175
280.3	36.5	37.3	36.5	36.7	36.5	37.6	37.4	38.5	37.4	37.1	34.7	32.2	31.6	29.4	26.1	21.5	1.488
280.6	36.9	38.0	38.1	37.4	37.1	38.2	38.3	39.3	38.2	37.8	35.2	32.5	31.5	29.1	26.2	21.8	1.974
281.6	38.4	39.6	38.4	39.2	39.2	40.6	40.6	41.5	40.2	39.5	36.5	33.0	31.9	29.7	26.1	21.5	3.240
282.0	39.2	40.2	39.3	40.1	40.0	41.3	41.1	42.4	41.0	39.9	37.0	33.4	31.9	29.4	25.9	21.6	3.727
283.0	40.8	42.1	41.4	42.0	41.6	43.4	43.2	44.4	42.7	41.7	37.9	34.3	32.5	29.5	26.0	21.7	5.048
283.4	41.4	42.9	42.0	42.5	42.4	44.1	44.2	45.1	43.4	42.1	38.5	34.8	32.6	29.7	25.9	21.5	5.567
284.4	42.8	44.7	43.4	44.3	44.2	46.3	46.0	46.9	44.6	43.6	39.5	35.5	33.3	29.9	26.0	21.5	6.843
284.8	44.1	45.7	44.9	45.2	45.3	47.1	46.7	47.6	45.6	44.1	40.1	36.1	33.3	30.0	25.8	21.5	7.383
285.2	44.4	46.3	44.3	45.7	45.6	47.8	47.5	48.4	46.1	44.5	40.3	36.4	33.7	30.0	25.8	21.5	7.882
286.2	46.0	48.1	47.8	47.5	47.2	49.7	49.1	49.9	47.7	45.8	41.2	37.1	34.1	29.9	25.8	21.3	9.212
286.6	47.3	48.8	47.7	48.2	48.1	50.4	49.7	50.6	48.1	46.4	41.7	37.3	34.4	30.6	25.9	21.5	9.724
287.0	47.2	49.3	48.1	48.8	48.8	50.7	50.3	51.1	48.6	46.6	41.9	37.5	34.4	30.3	25.8	21.8	10.244
288.0	48.8	51.1	49.4	50.7	50.1	52.5	52.2	52.8	50.2	48.1	42.8	38.1	35.2	30.9	25.8	21.5	11.571
288.4	49.6	52.0	50.3	51.3	51.0	53.6	53.0	53.3	50.7	48.3	43.3	38.8	35.2	30.9	25.9	21.4	12.089
289.4	51.0	53.5	51.0	52.5	52.2	54.9	54.2	54.8	51.7	49.5	44.4	39.4	35.6	31.3	25.9	21.6	13.492
289.7	51.8	54.3	52.2	53.5	53.7	55.6	55.3	55.3	52.3	49.7	44.8	39.8	36.0	31.4	26.0	21.6	14.019
290.7	52.8	55.6	53.9	54.9	55.0	57.1	56.3	56.7	53.6	50.8	45.4	40.4	36.6	31.8	25.8	21.5	15.381
291.7	54.5	57.0	55.3	55.3	55.3	58.2	57.5	57.9	54.7	51.8	46.2	41.0	37.1	32.1	25.7	21.5	16.755
292.1	54.2	57.2	55.6	56.1	55.8	58.7	57.8	58.5	54.9	52.3	46.9	41.5	37.4	32.6	25.9	21.6	17.307
293.1	56.5	58.9	58.6	57.5	56.9	59.8	59.2	59.7	56.0	53.2	47.2	42.1	37.9	32.4	25.8	21.8	18.673
293.5	56.7	59.1	58.2	58.2	57.7	60.1	59.6	60.2	56.6	53.8	47.7	42.2	38.2	32.8	25.7	21.6	19.231
294.5	57.0	60.2	57.9	59.4	59.4	61.4	60.7	61.1	57.1	54.4	48.4	42.9	38.5	33.2	25.6	21.6	20.672
295.5	58.6	61.5	58.8	60.1	59.9	62.1	61.2	61.9	57.9	54.8	48.4	43.4	39.2	33.5	25.6	21.5	22.086
295.9	59.4	61.9	60.7	61.1	60.5	63.3	62.5	62.4	58.6	55.6	49.2	43.6	39.4	33.3	26.0	21.5	22.624
296.9	60.0	62.9	60.3	61.3	61.6	64.5	63.8	63.5	59.7	56.3	50.0	44.2	39.8	34.1	25.6	21.5	24.024
297.9	60.9	64.1	61.5	62.3	61.8	65.3	64.3	64.6	60.8	57.2	50.3	44.6	40.2	34.0	25.7	21.7	25.426
298.9	62.2	65.4	61.8	63.8	63.3	66.2	65.5	65.4	61.6	58.2	51.3	45.4	40.7	34.6	25.6	21.5	26.829
299.3	62.8	65.7	61.9	63.4	63.2	66.3	65.4	65.6	61.7	58.0	51.0	45.3	40.7	34.7	25.7	21.9	27.381
300.3	62.9	66.1	63.3	63.7	63.8	67.3	65.9	66.6	62.3	58.7	51.9	46.0	41.2	35.0	25.5	21.5	28.804
301.3	63.8	67.2	65.5	65.5	64.4	67.9	67.1	67.2	62.9	59.3	52.3	46.5	41.7	35.5	25.8	21.5	30.239
302.3	64.7	67.9	65.4	66.2	65.6	68.5	67.6	68.2	63.7	60.1	52.5	47.0	42.3	36.0	25.5	21.5	31.648
303.3	65.0	68.4	65.5	66.6	66.6	69.5	68.2	68.6	64.0	60.5	53.6	47.5	42.3	35.8	25.6	21.5	33.086
304.3	65.5	69.1	66.6	67.0	66.7	69.9	68.4	69.2	64.7	60.6	53.3	47.8	42.8	36.3	25.6	21.8	34.522
305.3	66.5	69.7	66.6	67.3	67.6	70.1	69.2	69.6	65.2	61.5	54.3	48.1	43.1	36.4	25.5	21.6	35.970
306.3	67.3	70.4	68.0	68.1	68.1	71.2	69.8	70.1	65.4	61.8	54.3	48.5	43.4	36.7	25.5	21.5	37.388
307.3	67.7	70.6	68.3	68.7	68.8	71.6	70.1	70.8	65.9	62.3	55.0	48.7	43.9	36.4	25.6	21.5	38.806
308.3	67.9	71.2	68.8	69.6	69.3	72.0	70.9	71.2	66.5	62.4	55.0	49.1	44.2	37.0	25.6	21.5	40.245
309.3	67.8	71.7	68.9	69.4	69.5	72.3	71.3	71.7	67.1	63.0	55.6	49.3	44.6	37.2	25.3	21.8	41.648
310.3	68.6	72.3	67.8	69.8	69.6	72.9	71.7	72.0	67.7	63.8	56.4	50.0	44.6	38.0	25.6	21.8	43.080
311.3	68.7	72.5	69.5	70.8	69.9	73.1	72.0	72.5	67.5	63.6	56.2	50.1	44.9	37.7	25.5	21.8	44.508
312.3	69.8	73.1	70.1	70.5	70.0	73.5	72.1	72.8	68.2	64.4	56.5	50.0	45.4	38.3	25.7	21.7	45.933
312.7	69.4	73.4	69.7	71.6	71.4	74.0	73.4	72.9	68.3	65.0	57.3	50.4	45.5	38.1	25.6	21.6	46.478
313.7	69.5	73.6	69.2	71.5	70.8	74.0	73.1	73.6	68.7	64.8	57.1	50.8	45.6	38.5	25.6	21.5	47.885
314.7	70.2	73.9	71.0	71.3	70.8	74.2	73.4	73.7	68.9	65.1	57.4	51.0	45.7	38.5	25.6	21.5	49.292
315.7	70.8	73.9	69.8	72.7	71.6	75.1	74.0	73.7	69.5	65.7	58.1	51.3	45.9	38.9	25.5	21.3	50.694

316.7	71.0	74.5	71.0	72.0	72.1	75.2	74.1	74.2	69.5	65.6	58.1	51.4	46.3	39.2	25.7	21.6	52.100
317.7	70.9	74.6	69.7	72.5	72.1	75.0	74.4	74.4	69.4	66.0	58.1	51.6	46.2	39.3	25.6	21.7	53.517
318.7	71.6	75.3	72.4	73.0	72.6	75.6	74.6	74.6	70.2	66.0	58.5	51.8	46.4	38.6	25.6	21.8	54.898
319.7	71.1	75.1	71.1	72.6	71.8	75.6	74.5	74.9	70.2	65.8	58.1	51.8	46.7	39.1	25.5	21.5	56.299
320.7	71.2	75.2	70.9	71.9	71.6	75.2	74.4	74.9	69.6	65.5	57.8	51.9	46.6	39.2	25.7	21.8	57.680
321.7	72.2	75.8	71.8	73.2	73.0	75.7	74.4	75.1	70.1	66.5	58.1	51.8	46.9	39.1	25.6	21.7	59.041
322.7	71.5	75.6	72.0	73.7	73.4	76.4	75.3	75.2	70.5	66.6	58.8	51.8	46.8	39.3	25.6	21.6	60.377
323.7	72.2	76.1	72.7	73.3	73.5	76.4	75.4	75.3	70.6	66.5	58.3	52.3	47.1	39.6	25.7	21.7	61.696
324.7	72.0	76.0	72.5	73.1	72.7	76.5	75.3	75.9	70.8	66.4	58.6	52.7	47.3	39.7	25.8	21.7	63.045
325.7	72.7	76.4	73.3	74.3	74.7	77.3	75.3	75.3	71.0	66.9	59.3	52.7	47.6	40.3	25.7	21.8	64.389
326.7	72.9	76.4	72.4	74.4	74.2	77.4	76.1	75.9	71.5	66.9	59.0	52.7	47.6	39.9	25.5	21.7	65.723
327.7	73.2	76.7	74.5	74.6	73.9	76.9	75.1	75.9	70.6	66.8	59.5	52.9	47.8	39.8	25.8	21.9	67.049
328.7	72.7	76.9	72.5	74.3	74.1	77.1	75.7	75.9	71.0	67.0	59.2	52.8	47.7	40.1	25.6	21.7	68.381
329.7	73.2	77.2	72.5	74.5	73.8	77.5	75.7	76.4	71.7	67.2	59.1	52.9	47.8	40.3	25.8	21.7	69.684
330.7	73.2	77.0	73.0	74.6	74.0	77.6	76.3	76.7	71.5	67.6	60.1	53.3	47.8	40.0	25.8	21.5	71.000
331.7	74.3	77.5	74.3	74.7	74.4	77.5	76.1	76.7	71.7	67.7	60.1	53.4	48.0	40.4	25.9	21.6	72.301
332.1	73.3	77.0	73.2	74.1	74.0	77.3	76.3	76.9	71.8	67.7	59.7	53.4	48.0	40.6	25.7	21.7	72.820
333.1	73.8	77.7	73.7	75.2	74.9	77.9	76.4	77.0	72.0	68.0	60.7	53.8	48.2	41.0	25.9	21.8	74.110
334.1	73.5	77.3	74.5	75.8	74.7	77.8	76.7	77.0	72.2	67.7	59.5	53.3	48.1	40.2	25.9	21.7	75.417
335.1	73.8	77.7	73.5	75.2	76.0	78.5	77.2	77.2	72.0	68.2	60.3	53.4	48.2	41.0	26.0	21.8	76.727
336.1	73.8	77.7	73.4	75.2	75.4	78.3	77.1	76.7	72.4	68.3	60.4	53.5	48.3	40.3	25.9	21.9	78.000
337.1	74.1	77.8	73.4	76.0	75.2	78.4	76.7	77.4	72.4	68.5	60.2	53.7	48.5	40.7	26.0	21.8	79.297
338.1	73.6	77.5	72.7	75.5	75.2	78.5	77.2	77.3	72.4	68.6	60.8	53.8	48.6	41.2	26.2	21.7	80.611
339.1	74.4	77.8	74.0	75.9	75.4	78.5	77.2	77.1	73.0	68.6	60.7	53.8	48.4	40.6	26.0	21.6	81.888
340.1	74.4	78.0	74.4	75.8	75.6	78.7	77.1	77.4	72.9	68.3	60.1	53.8	49.0	41.1	26.0	21.9	83.202
341.1	73.8	77.7	73.9	75.7	75.1	77.9	76.2	77.4	72.3	67.7	59.3	53.4	48.5	40.6	26.0	21.6	84.501
342.1	72.8	76.5	72.7	74.8	75.2	77.8	76.7	75.9	70.7	66.4	59.2	53.5	48.5	41.1	26.3	21.6	85.785
343.1	71.6	75.2	71.8	72.9	72.9	76.4	74.5	74.2	68.5	64.1	57.8	52.9	48.3	40.9	26.2	22.0	87.074
343.5	71.5	74.8	71.4	71.9	71.6	75.3	73.6	73.3	67.7	63.5	57.4	52.6	48.2	41.0	26.1	21.7	87.550
344.5	69.5	72.9	69.3	70.5	70.2	73.4	71.2	70.9	65.7	61.6	55.9	51.7	47.7	40.7	26.0	21.7	88.868
344.9	69.3	72.4	69.1	69.6	69.7	72.7	71.4	70.3	64.8	61.9	56.2	51.5	47.5	40.8	26.3	21.6	89.369
345.9	67.9	70.6	67.4	68.2	67.3	70.3	68.8	68.2	63.3	59.6	54.7	50.6	47.4	40.2	26.1	21.6	90.646
346.3	67.1	70.2	65.7	67.0	67.1	69.6	68.3	67.5	62.9	59.7	54.6	50.5	47.0	40.3	26.3	21.8	91.150
347.3	65.0	67.9	64.0	65.9	64.7	67.3	65.8	65.4	61.1	58.0	53.0	49.6	46.2	39.8	26.3	21.8	92.426
347.6	64.1	67.5	63.6	64.5	64.8	66.7	65.3	64.8	60.6	57.6	52.7	49.3	46.2	39.7	26.3	21.9	92.924
348.7	61.4	65.6	62.0	62.5	62.7	64.8	63.5	62.9	59.0	56.1	51.8	48.4	45.4	39.6	26.3	21.8	94.188
349.0	61.2	64.9	61.5	61.5	60.5	63.3	61.8	61.9	57.9	55.2	51.1	48.2	45.2	39.6	26.5	21.7	94.680
350.0	59.1	63.1	59.7	60.0	59.8	61.7	60.2	60.7	56.9	54.7	50.3	47.3	44.7	38.4	26.4	22.0	95.936
350.4	58.9	62.7	60.1	59.4	58.8	61.5	59.9	60.1	56.5	54.0	49.9	47.1	44.5	39.0	26.5	21.7	96.420
351.4	57.7	61.1	57.6	58.0	57.3	60.0	58.8	58.5	55.1	52.8	48.6	46.3	43.8	38.7	26.5	21.8	97.671
351.8	57.6	60.6	57.5	58.0	57.4	59.5	58.1	58.1	54.8	52.5	48.6	46.1	43.5	38.5	26.5	21.6	98.150
352.8	56.0	59.2	56.2	56.1	55.6	57.9	56.5	56.7	53.2	51.4	47.9	45.3	43.1	38.0	26.3	21.7	99.390
353.2	55.2	58.6	56.0	55.7	54.9	57.3	56.3	56.2	52.9	50.9	47.6	45.0	42.8	37.4	26.4	21.7	99.876
354.2	54.4	57.3	54.4	54.7	54.2	55.9	54.7	54.9	51.8	50.1	46.7	44.5	42.4	37.4	26.4	21.8	101.091
355.2	52.8	55.9	53.5	53.4	52.9	54.8	53.6	53.6	51.0	49.3	46.2	43.7	41.5	36.9	26.4	21.8	102.334
355.6	52.7	55.6	52.2	53.3	53.3	54.6	53.1	53.3	50.4	48.6	45.6	43.5	41.3	36.8	26.5	21.5	102.803
356.6	51.5	54.2	51.8	52.1	51.0	53.1	52.2	52.3	49.1	47.7	45.1	42.7	41.0	36.1	26.6	21.8	104.006
357.0	51.3	53.9	51.2	51.9	51.2	52.8	51.9	51.9	49.1	47.5	44.7	42.6	40.8	36.0	26.5	21.7	104.471
358.0	50.0	52.8	50.6	50.6	50.0	51.8	50.8	51.0	48.4	46.8	44.1	42.1	40.2	35.9	26.6	21.7	105.700
358.4	49.9	52.3	50.2	50.4	50.2	51.6	50.3	50.4	48.1	46.6	43.6	41.9	40.0	35.9	26.4	21.5	106.173

359.4	48.8	51.4	49.0	49.6	49.0	50.5	49.7	49.8	47.1	45.8	43.2	41.3	39.6	35.5	26.5	21.7	107.359
359.8	48.8	50.9	48.9	48.8	48.6	50.1	49.4	49.5	47.0	45.5	42.8	41.0	39.4	35.2	26.5	21.8	107.840
360.8	47.6	49.8	47.8	47.9	47.6	49.5	48.7	48.6	46.2	44.6	42.0	40.5	38.8	35.1	26.6	21.8	109.051
361.1	46.8	49.5	47.7	47.7	47.0	48.7	48.0	48.1	45.7	44.4	42.1	40.2	38.8	34.7	26.5	21.8	109.522
362.1	46.6	49.0	46.8	47.2	46.8	48.3	47.2	47.4	45.2	43.8	41.4	39.9	38.3	34.8	26.5	21.8	110.718
363.1	46.1	48.0	45.9	46.2	45.8	47.3	46.5	46.7	44.4	43.3	41.0	39.4	37.9	33.9	26.5	21.7	111.929
364.1	45.2	47.2	45.4	45.4	45.0	46.4	45.8	45.9	43.7	42.4	40.4	38.7	37.4	33.6	26.5	21.8	113.117
365.1	44.6	46.5	45.1	45.0	44.6	45.8	44.9	45.2	43.3	42.0	39.9	38.3	37.0	33.8	26.5	21.8	114.306
366.1	43.8	45.7	44.5	44.4	43.7	45.1	44.6	44.7	42.6	41.2	39.4	38.0	36.7	33.3	26.5	21.8	115.512
367.1	43.3	45.2	43.0	43.6	43.3	44.8	44.0	44.1	42.1	41.2	39.2	37.5	36.6	33.0	26.4	21.3	116.736
368.1	42.6	44.6	43.0	43.2	42.9	44.1	43.5	43.7	41.5	40.6	38.7	37.4	36.3	32.9	26.5	21.4	117.936
369.1	42.1	43.9	42.3	42.5	42.1	43.7	42.9	43.2	41.1	40.1	38.2	37.0	35.7	32.6	26.4	21.5	119.165
370.1	41.7	43.4	42.0	41.9	41.4	42.9	42.3	42.6	40.6	39.5	37.6	36.5	35.3	32.2	26.5	21.8	120.346
371.1	41.2	42.9	41.4	41.5	41.5	42.6	42.0	42.3	40.4	39.1	37.6	36.2	35.2	32.5	26.4	21.3	121.557
372.1	40.4	42.1	40.9	41.0	40.8	41.9	41.2	41.5	39.7	38.7	36.9	35.8	35.1	32.1	26.5	21.4	122.780
373.1	40.5	41.9	40.7	40.9	40.5	41.4	41.0	41.2	39.5	38.4	36.8	35.4	34.4	31.7	26.4	21.5	124.010
374.1	40.1	41.5	40.1	40.6	40.2	41.3	40.8	40.9	39.1	38.1	36.4	35.1	34.2	31.6	26.5	21.5	125.230
375.1	39.2	40.9	39.7	39.8	39.5	40.6	40.1	40.3	38.8	37.6	35.9	34.9	34.0	31.4	26.5	21.4	126.445
376.1	39.2	40.7	39.5	39.7	39.2	40.4	39.9	40.1	38.5	37.4	35.9	34.5	33.6	31.1	26.4	21.5	127.662
377.1	38.9	40.2	39.2	39.2	38.9	40.0	39.3	39.6	37.9	37.0	35.5	34.3	33.5	30.7	26.4	21.6	128.901
378.1	38.5	39.9	38.8	38.7	38.6	39.6	39.1	39.3	37.7	36.8	35.2	33.9	33.0	30.6	26.5	21.7	130.089
379.1	37.9	39.3	38.3	38.0	37.7	39.1	38.8	39.0	37.3	36.4	34.6	33.6	32.8	30.4	26.5	21.7	131.313
380.1	38.0	39.3	37.8	38.3	38.0	38.8	38.5	38.5	37.0	36.1	34.7	33.6	32.9	30.0	26.3	21.8	132.545
381.1	38.0	39.1	37.5	38.1	38.0	38.8	38.4	38.4	36.9	35.8	34.5	33.3	32.3	30.3	26.4	21.7	133.744
382.1	37.3	38.5	37.9	37.4	37.2	38.1	37.9	38.1	36.4	35.4	34.3	33.1	32.2	30.2	26.3	21.6	134.986
383.1	37.3	38.3	37.4	37.3	37.2	38.1	37.6	37.9	36.1	35.2	33.6	32.8	31.9	29.7	26.5	21.5	136.211
384.1	36.6	37.9	36.7	37.0	36.6	37.7	37.4	37.6	35.8	35.0	33.8	32.6	31.8	29.8	26.2	21.5	137.441
385.1	36.7	37.7	36.9	36.8	36.5	37.4	37.1	37.4	35.6	34.8	33.5	32.5	31.7	29.6	26.3	21.7	138.744
386.1	36.0	37.3	36.2	36.5	36.1	37.2	36.8	37.1	35.3	34.8	33.4	32.4	31.7	29.3	26.2	21.6	140.031
387.1	35.7	37.0	36.7	36.2	35.9	37.0	36.6	37.0	35.3	34.5	33.3	32.2	31.3	28.9	26.2	21.5	141.303
388.1	35.9	36.9	35.9	36.2	35.8	36.7	36.3	36.6	35.0	34.3	33.0	32.0	31.1	28.9	26.2	21.8	142.592
389.2	35.7	36.7	35.9	36.0	35.7	36.7	36.1	36.5	35.0	34.1	32.7	31.6	30.8	28.9	26.1	21.7	143.870
390.2	35.7	36.4	35.3	35.6	35.4	36.4	36.0	36.2	34.8	33.9	32.8	31.7	30.8	28.6	26.0	21.5	145.157
391.2	35.1	36.2	35.1	35.3	35.2	36.2	35.8	36.0	34.4	33.5	32.5	31.5	30.6	28.6	26.2	21.5	146.418
392.2	35.1	36.1	35.4	35.4	35.1	36.1	35.8	35.9	34.5	33.5	32.4	31.3	30.6	28.8	26.0	21.6	147.705
393.2	34.8	35.9	35.2	35.1	34.9	35.8	35.4	35.8	34.2	33.5	32.2	31.2	30.6	28.6	25.9	21.5	148.994
394.2	34.5	35.7	34.8	35.1	35.0	35.7	35.4	35.7	34.1	33.5	32.1	31.1	30.2	28.0	26.2	21.6	150.292
395.2	34.5	35.5	35.3	34.8	34.6	35.7	35.2	35.5	34.2	33.1	32.0	30.9	30.2	28.4	25.9	21.5	151.587
396.2	34.7	35.5	34.6	34.8	34.5	35.5	35.2	35.3	33.8	33.0	31.7	30.6	30.1	28.3	26.0	21.6	152.904
397.2	34.3	35.3	34.7	34.6	34.0	35.1	34.7	35.1	33.4	32.7	31.4	30.6	29.9	28.1	26.0	21.5	154.194
398.2	34.4	35.2	34.6	34.5	34.3	35.2	34.8	35.0	33.6	32.7	31.5	30.6	29.7	27.9	26.0	21.5	155.480
399.2	34.2	35.1	34.3	34.3	34.2	35.0	34.7	34.9	33.4	32.6	31.6	30.6	29.6	28.0	25.9	21.5	1.496
400.2	34.3	34.9	34.0	34.5	34.3	35.0	34.4	34.7	33.2	32.4	31.4	30.3	29.4	27.6	25.9	21.8	2.771
401.2	33.9	34.9	34.0	34.2	33.9	34.9	34.4	34.8	33.4	32.4	31.2	30.1	29.4	27.7	25.8	21.7	4.034
402.2	33.9	34.7	34.0	34.0	33.9	34.7	34.4	34.5	33.0	32.4	31.1	30.0	29.2	27.6	25.7	21.8	5.335
403.2	33.7	34.6	33.7	34.0	33.4	34.6	34.2	34.4	33.1	32.1	30.8	29.9	29.2	27.4	25.6	21.5	6.640
404.2	33.4	34.4	33.5	33.9	33.6	34.3	34.1	34.4	32.8	32.1	31.1	30.1	29.1	27.2	25.6	21.5	7.957
405.2	33.4	34.2	33.2	33.5	33.3	34.2	33.8	34.1	32.7	32.0	31.0	29.8	29.1	27.0	25.6	21.5	9.300
406.2	33.4	34.2	33.0	33.5	33.1	34.1	33.8	34.0	32.5	31.7	30.5	29.4	28.8	26.9	25.4	21.4	10.625
407.2	33.2	34.1	33.6	33.6	33.2	34.1	33.8	34.2	32.5	31.9	30.8	29.5	28.7	27.1	25.6	21.5	11.985

408.2	32.9	33.8	33.3	33.4	33.1	33.9	33.8	34.0	32.3	31.5	30.5	29.4	28.8	26.8	25.3	21.4	13.341
409.2	33.1	33.8	33.1	33.4	33.1	33.8	33.7	33.7	32.2	31.5	30.4	29.4	28.8	26.7	25.5	21.3	14.715
410.2	33.0	33.8	33.0	33.3	33.0	34.1	33.6	33.8	32.5	31.6	30.4	29.5	28.7	26.5	25.4	21.3	16.143
411.2	32.9	33.8	32.7	33.0	33.0	33.8	33.6	33.8	32.2	31.4	30.3	29.3	28.6	26.3	25.4	21.5	17.564
412.2	32.7	33.7	33.1	33.1	32.9	33.7	33.5	33.8	32.2	31.3	29.9	29.1	28.4	26.4	25.3	21.6	18.963
413.2	32.7	33.6	33.0	33.1	32.8	33.7	33.3	33.6	32.2	31.4	30.3	29.2	28.4	26.6	25.5	21.5	20.431
414.2	32.6	33.4	32.8	32.9	32.6	33.5	33.0	33.4	32.0	31.2	30.1	28.9	28.3	26.5	25.1	21.2	21.878
415.2	32.8	33.5	33.1	33.1	32.8	33.6	33.2	33.6	32.0	31.3	30.3	29.3	28.4	26.4	25.3	21.4	23.308
416.2	32.6	33.5	32.9	32.9	32.8	33.6	33.4	33.5	32.0	31.3	30.3	29.0	28.4	26.7	25.3	21.5	24.744
417.2	32.7	33.4	33.0	33.0	32.5	33.5	33.2	33.4	32.0	31.1	30.2	29.0	28.0	26.0	25.2	21.4	26.186
418.2	32.2	33.4	32.5	32.7	32.3	33.3	33.1	33.3	31.9	31.2	30.1	28.9	28.2	26.2	25.0	21.2	27.656
419.2	32.8	33.4	33.3	32.8	32.4	33.3	32.9	33.1	31.9	31.2	29.9	28.9	28.1	26.0	25.1	21.4	29.106
420.2	32.7	33.5	32.5	32.9	32.6	33.6	33.3	33.4	32.0	31.2	30.1	29.1	28.3	26.3	25.1	21.4	30.571
421.2	32.7	33.4	33.0	33.0	32.7	33.5	33.2	33.3	32.0	31.2	30.0	29.0	28.2	26.1	25.3	21.5	32.042
422.2	32.7	33.5	32.4	32.7	32.4	33.5	33.1	33.4	31.9	31.2	30.0	28.9	28.1	26.3	25.1	21.5	33.531
423.2	32.7	33.5	32.9	32.9	32.9	33.6	33.2	33.4	32.0	31.2	30.0	29.0	28.2	26.3	25.0	21.3	35.046
424.2	32.6	33.5	32.9	32.9	32.6	33.5	33.1	33.4	32.0	31.1	30.0	28.8	28.2	26.3	25.1	21.5	36.534
425.2	32.7	33.5	32.7	33.1	32.8	33.5	33.3	33.4	32.2	31.1	30.0	28.7	28.0	26.4	25.1	21.4	38.017
426.2	33.0	33.6	32.8	33.0	32.9	33.6	33.5	33.5	32.1	31.3	30.2	28.7	27.9	26.4	24.8	21.2	39.518
427.2	32.8	33.6	33.0	33.1	32.8	33.6	33.3	33.6	32.2	31.3	30.1	28.9	28.0	26.2	24.9	21.5	41.036
428.2	32.9	33.6	33.2	33.0	32.9	33.9	33.5	33.8	32.1	31.3	29.8	28.7	28.0	26.2	24.8	21.5	42.498
429.2	32.9	33.9	33.2	33.3	32.9	33.9	33.6	33.7	32.3	31.3	30.1	28.9	28.0	26.1	24.9	21.2	44.036
430.2	33.3	34.0	33.4	33.3	33.0	33.9	33.5	33.8	32.2	31.2	30.2	28.8	28.1	26.1	24.8	21.4	45.542
431.2	33.3	34.0	33.2	33.5	33.1	33.9	33.8	33.8	32.2	31.4	30.1	28.8	27.9	26.0	24.9	21.5	47.018
432.2	33.2	34.0	33.6	33.3	33.1	33.9	33.8	33.7	32.4	31.4	30.1	28.8	28.0	26.2	24.5	21.1	48.551
433.2	33.3	34.1	33.3	33.6	33.3	34.1	33.8	33.8	32.5	31.5	30.2	29.0	28.2	26.1	24.6	21.4	50.066
434.2	33.1	33.5	32.7	32.4	32.4	33.2	33.7	33.9	32.5	31.2	30.1	28.9	27.9	26.1	24.8	21.4	51.564
435.2	33.3	34.1	31.4	31.6	31.5	32.3	31.7	33.2	32.4	30.7	29.7	28.8	28.0	25.9	24.8	21.5	53.047
436.2	33.3	34.1	32.6	32.4	32.3	33.1	32.7	33.8	32.5	31.3	30.1	28.9	27.8	26.1	24.8	21.5	54.522
437.2	33.2	34.2	33.7	33.1	32.9	33.6	33.3	33.8	32.5	31.6	30.2	28.9	27.8	26.1	24.6	21.5	56.003
438.2	33.5	34.2	34.3	33.3	33.1	33.8	33.4	33.9	32.5	31.6	30.5	28.8	27.9	26.2	24.7	21.5	57.432
439.2	33.6	34.4	33.4	33.5	33.3	34.1	33.6	34.1	32.7	31.6	30.3	29.0	28.1	26.4	24.7	21.4	58.906
440.2	33.5	34.3	33.7	33.7	33.4	34.1	33.7	33.6	32.5	31.6	30.2	28.9	28.0	26.4	24.8	21.5	60.373
441.2	33.6	34.3	33.7	33.6	33.3	34.2	33.6	33.8	32.5	31.6	30.3	29.0	28.2	26.2	24.5	21.2	61.863
442.2	33.6	34.4	33.8	33.7	33.5	34.1	33.8	34.1	32.8	31.8	30.3	29.1	28.0	25.7	24.5	21.4	63.309
443.2	33.6	34.3	33.7	33.6	33.4	34.2	33.8	34.1	32.5	31.9	30.4	28.9	27.9	25.9	24.7	21.7	64.744
444.2	33.4	34.2	33.4	33.6	33.3	34.4	34.0	34.1	32.6	31.6	30.3	28.8	27.9	25.9	24.6	21.3	66.153
445.2	33.5	34.4	33.4	33.4	33.0	34.2	33.8	34.1	32.6	31.6	30.2	28.9	27.9	25.9	24.5	21.3	67.561
446.2	33.6	34.4	33.2	33.7	33.4	34.4	34.0	34.1	32.8	31.6	30.3	29.0	28.2	26.0	24.9	21.4	69.034
447.2	33.4	34.2	33.4	33.6	33.6	34.4	33.8	34.1	32.4	31.5	30.2	29.0	28.3	25.7	24.5	21.4	70.504
448.2	33.2	33.9	33.2	33.3	32.3	33.9	31.8	32.9	31.2	30.8	30.0	29.0	28.1	25.5	24.4	21.4	71.946
449.2	32.9	33.5	32.9	32.8	32.4	33.3	31.5	32.7	30.8	30.0	28.0	28.7	27.5	25.7	24.3	21.3	73.432
450.2	32.5	33.1	32.5	32.5	32.2	32.8	32.0	32.5	31.0	30.3	28.3	28.7	27.9	25.4	24.4	21.3	74.922
451.2	32.1	32.6	32.1	32.1	31.8	32.5	32.0	32.1	30.6	29.9	28.8	28.5	27.8	25.3	24.3	21.5	76.383
452.2	31.6	32.1	31.6	31.6	31.4	32.0	31.4	31.7	30.3	29.7	28.9	28.3	27.6	24.8	24.5	21.3	77.897
453.2	31.8	32.0	31.8	31.6	31.3	31.7	31.4	31.4	30.1	29.6	28.7	27.9	27.4	25.1	24.2	21.3	79.396
454.2	31.5	31.7	31.1	31.3	30.9	31.4	30.9	31.1	29.9	29.2	28.6	28.1	27.3	24.8	24.3	21.4	80.910
455.2	31.3	31.4	31.0	31.1	30.7	31.1	30.6	30.6	29.8	29.1	28.6	27.8	27.1	24.8	24.2	21.2	82.409
456.2	31.0	31.1	30.9	30.7	30.3	30.7	30.3	30.3	29.5	28.8	28.3	27.5	27.4	24.6	24.4	21.4	83.936
457.2	30.6	30.6	30.4	30.3	29.9	30.3	30.0	30.0	29.0	28.5	28.0	27.5	26.9	24.8	24.3	21.5	85.427

Grooved Plate Dryout Experiment Data Sheet

Date: 23 Sep 92 Time: 1538 Run Designation: G3E1

Runtime (min)	Amps	Volts	Comments	Dryout Length
			Δt = W-C = 1.4 - 1.0 = 0.4	
C7.4			T_{13} is reading 2 C low because it's in puddle	
			I've tried to dam up groove but not successful. Scale reading at C = 4.4 my fault m_{tot} = 0.061 - 0.062 gm/sec Δt = W - C = 12.8 - 12.4 = 0.4	
C12.4	2.154	25.18		
C19.6	2.151	25.16	Check on power - Small puddle at dam. Small overrun on end of groove.	
C46.3			Unplugged groove T_2, T_{12}, and T_{11} are acting weird	
C52.3			Emptied flask. Groove having problems!	
C55.3	2.747	32.22	Upped power. Note: the noticeable changes in m_{dot}!	
C73.0	2.745	32.23	meniscus noticeably (~2/3) depressed in groove.	
C86.4			Groove appears to be dried out	4cm
			I swabbed out end of groove to make sure it's clean fluid and by the time it rewets it could be dirty again	7.0
C96.4	2.743	32.22		
C102.2			front is hard to define. I tried cleaning and it doesn't make defined front.	7.0 - 8.0
C109.2			emptied flask	
C110.2			I see a better front definition	10.5
C111.2			I see a better front definition	9.8

Grooved Plate Dryout Experiment Data Sheet

Date: 23 Sep 92 Time: 1538 Run Designation: G3E1

Runtime (min)	Amps	Volts	Comments	Dryout Length
C116.2			It's very hard to say where front is T_3=74	9 - 11
			Groove is certainly dried out	
W119			Power down	10
W120.6			Front on the move T_2=71.5	8
W121.0				6
W121.3			T_1=70.2	4
W121.5				2
W121.8			Rewet T_6=69.8	0
			It didn't take long for the front to start moving. It moved quickly forward ⇒ 8 cm in 1.2 minutes	

RUN LETTER DESIGNATION: G3E1
DATE: 09-23-1992 TIME: 15:43:21
GROOVE NUMBER: 3
THE RELATIVE HUMIDITY IS 29.233 MM OF MERCURY
THE FLOWMETER SETTING IS : 25
THE PLATE ANGLE IS 0 SCALE IN GRAMS; T15 = 21 C

TIME(s)	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	SCALE
60.5	21.3	20.9	21.1	21.3	21.3	21.2	21.2	21.1	20.2	20.1	20.1	20.3	20.5	19.2	20.3	45.350
83.5	21.2	20.9	21.2	21.3	21.1	21.0	21.1	21.1	19.9	20.3	20.1	20.2	20.3	19.2	20.3	46.895
143.5	21.2	20.8	21.2	21.3	21.2	21.0	21.1	21.1	20.3	20.2	20.3	20.4	20.5	18.9	20.3	50.989
203.6	21.2	20.9	21.2	21.4	21.3	21.1	21.0	21.2	20.0	20.0	20.4	20.2	20.3	19.4	20.3	55.046
263.6	21.3	20.9	21.2	21.3	21.2	21.1	21.1	21.1	20.2	20.3	20.4	20.3	20.4	19.0	20.3	142.238
323.6	21.2	20.8	21.2	21.1	21.3	21.1	21.1	21.1	20.0	20.0	20.5	20.2	20.4	19.2	20.3	5.086
383.7	21.3	21.0	21.2	21.3	21.2	21.0	20.9	21.0	19.9	20.1	20.2	20.4	20.5	19.2	20.3	9.125
443.7	21.2	20.9	21.2	21.2	21.2	21.1	20.8	21.1	20.2	19.9	20.3	20.4	20.3	19.1	20.3	13.159
503.7	21.3	20.9	21.2	21.2	21.1	20.9	21.0	21.0	19.9	20.2	19.9	20.4	20.6	19.1	20.4	17.135
563.8	21.3	21.0	21.2	21.3	21.1	21.0	20.9	20.8	20.2	20.3	20.6	20.4	20.4	19.2	20.1	21.161
623.8	21.2	20.9	21.1	21.1	21.2	21.0	20.9	21.0	19.9	20.0	20.2	20.4	20.2	19.4	20.5	25.212
683.8	21.1	20.9	21.1	21.1	21.1	20.9	20.9	21.1	20.0	19.8	20.4	20.3	20.2	19.2	20.2	29.196
743.9	21.2	20.9	21.1	21.1	21.1	20.9	20.9	21.1	19.9	20.3	20.0	20.3	20.4	19.0	20.3	33.238
803.9	21.3	21.1	21.3	21.4	21.3	21.0	21.1	21.2	20.2	20.1	20.5	20.3	20.7	19.2	20.3	37.288
863.9	22.2	22.2	22.7	22.9	22.8	22.5	22.5	22.6	21.3	21.5	21.6	20.5	21.8	19.3	20.2	41.299
924.0	23.1	23.7	24.4	24.6	24.3	24.0	23.9	23.6	22.7	22.7	23.1	20.8	23.2	19.3	20.4	45.382
984.0	24.3	25.5	26.1	26.6	26.0	25.6	25.7	25.4	24.5	24.3	24.6	21.5	24.8	19.6	20.3	49.461
1007.1	24.8	26.1	26.6	27.1	26.5	26.0	26.2	25.8	24.9	25.3	25.4	21.5	25.7	19.7	20.3	50.984
1067.1	26.5	27.6	28.3	28.9	28.0	27.2	27.7	27.3	26.2	26.5	26.5	22.3	26.9	19.8	20.1	55.061
1090.1	27.0	28.2	28.7	29.6	29.1	27.5	29.2	27.3	26.5	26.6	26.8	22.4	26.9	20.1	20.4	56.637
1150.0	28.5	29.8	30.3	31.0	30.4	28.9	31.0	28.7	27.5	27.7	27.9	23.2	28.2	20.5	20.4	60.650
1173.4	28.7	30.3	31.0	31.7	30.5	29.5	31.6	29.1	27.9	27.9	28.3	23.4	28.8	20.5	20.5	62.233
1233.4	30.3	31.7	32.3	31.9	32.6	30.6	32.9	30.3	29.0	29.3	29.5	23.8	29.8	20.7	20.5	66.310
1256.4	30.8	32.3	32.8	33.6	33.0	31.0	33.3	30.4	29.5	29.3	29.9	24.1	30.1	21.0	20.4	67.832
1316.4	32.2	33.5	34.1	34.9	34.2	31.9	34.7	31.4	30.2	30.4	30.6	24.7	31.0	21.1	20.4	71.912
1339.3	32.3	33.9	34.4	35.5	34.8	32.2	35.3	31.6	30.8	30.6	31.0	24.8	31.5	21.4	20.4	73.491
1399.3	33.5	35.0	35.7	36.5	35.6	33.1	36.3	32.4	31.5	31.5	31.8	25.5	32.2	21.6	20.3	77.515
1422.7	34.1	35.4	36.1	36.9	36.2	33.3	36.8	32.6	32.0	31.8	32.4	25.4	32.5	22.0	20.4	79.093
1482.7	35.6	36.6	37.3	38.1	37.3	34.3	37.7	33.7	32.8	33.0	32.6	26.0	33.3	22.3	20.3	83.176
1505.7	36.3	37.3	38.0	38.5	37.8	34.7	38.2	34.2	33.3	33.5	33.4	26.3	33.9	22.5	20.4	84.706
1565.7	37.2	38.3	38.8	39.5	38.8	35.4	39.2	34.8	34.0	34.1	34.1	26.8	34.5	23.0	20.3	88.803
1625.7	38.3	39.2	39.7	40.6	39.9	36.2	39.8	35.7	34.8	35.0	35.2	27.3	35.3	23.4	20.3	92.911
1648.8	38.8	39.5	40.0	40.7	40.0	36.8	39.8	35.9	35.2	35.3	35.3	27.8	35.9	23.3	20.4	94.438
1708.8	39.6	40.5	41.0	41.8	41.2	37.6	40.3	36.7	35.6	36.2	36.2	28.0	36.7	23.7	20.3	98.560
1768.9	40.5	41.3	41.9	42.6	41.9	38.2	41.0	37.3	36.4	37.3	36.8	28.6	37.3	24.1	20.4	102.651
1828.9	41.2	42.0	42.6	43.5	42.7	38.5	42.9	37.8	36.8	37.5	36.8	29.1	37.5	24.1	20.4	106.738
1888.9	41.9	42.8	43.3	44.0	43.4	39.2	43.4	37.9	37.2	38.1	37.8	29.1	38.3	24.4	20.7	110.769
1949.0	42.7	43.6	44.1	45.0	44.2	39.8	44.4	39.0	38.1	38.6	38.5	29.6	38.8	24.5	20.7	114.867
2009.0	43.4	44.2	44.6	45.5	44.7	40.4	44.7	39.2	38.3	39.2	38.8	30.2	39.5	25.3	20.8	118.946
2069.0	43.8	44.7	45.3	46.0	45.2	40.7	45.5	39.9	39.0	40.0	39.7	30.5	40.2	25.0	20.6	122.975
2129.1	44.4	45.3	45.6	46.8	45.9	41.4	46.0	40.4	39.6	40.2	39.9	30.9	40.3	25.6	20.8	127.068
2189.1	45.2	46.0	46.4	47.3	46.2	42.0	46.6	40.9	40.1	40.9	40.5	31.1	40.8	25.6	20.9	131.161

2249.1	45.7	46.6	46.9	47.9	47.1	42.4	47.2	41.3	40.4	41.3	40.6	31.5	41.7	25.8	20.9	135.195
2309.2	46.2	47.0	47.2	48.3	47.4	42.9	47.7	42.0	41.3	41.7	41.0	31.8	42.1	26.1	21.0	139.281
2369.2	45.2	46.5	47.7	47.4	47.4	44.9	47.5	42.3	41.2	41.9	37.9	30.2	42.5	26.2	21.1	143.314
2429.2	46.9	47.8	48.5	48.7	48.2	45.1	48.4	43.0	42.3	42.2	39.0	30.7	43.0	26.4	21.3	147.323
2452.6	47.1	47.8	48.5	48.9	48.3	45.1	48.3	43.2	42.1	42.2	39.1	31.1	42.9	26.2	21.4	148.810
2512.6	46.2	47.7	48.5	49.4	48.5	45.3	48.6	43.5	42.9	42.8	39.5	31.6	43.3	26.8	21.4	152.780
2572.6	46.7	48.8	49.2	50.1	49.2	45.8	49.1	43.8	43.2	43.4	39.9	32.3	43.6	27.3	21.4	156.732
2632.6	47.8	49.3	49.5	50.3	49.5	46.0	49.5	44.3	43.5	43.6	40.3	32.5	43.9	27.3	21.7	160.671
2656.0	48.0	49.3	49.7	50.5	49.5	46.2	49.7	44.3	43.0	43.5	40.3	32.2	44.3	27.5	21.4	162.139
2716.0	48.5	49.7	50.0	50.8	49.7	46.4	50.0	44.4	43.8	44.1	40.5	32.7	44.8	27.3	21.7	166.080
2776.0	48.9	49.8	50.2	51.1	50.2	46.5	50.3	45.0	44.0	44.3	40.9	32.7	44.7	27.9	21.8	170.037
2836.1	48.9	50.1	50.2	51.1	50.0	46.8	50.3	44.8	43.7	44.2	41.0	32.4	45.0	27.7	21.7	173.992
2896.1	49.2	50.1	50.3	51.4	50.7	47.1	50.4	45.0	44.5	44.5	41.2	32.9	45.3	28.3	21.8	177.868
2956.1	49.7	50.7	51.2	52.0	51.0	47.7	51.0	45.5	44.7	45.0	41.6	33.0	45.8	28.3	22.0	181.808
3016.2	50.0	50.9	51.3	52.1	51.1	47.5	51.3	45.8	45.1	45.3	41.9	33.7	45.8	28.6	22.1	185.747
3076.2	50.3	51.3	51.4	52.4	51.5	47.9	51.6	45.9	45.2	45.3	42.1	33.4	46.1	28.6	22.0	189.631
3136.2	50.3	51.4	51.8	52.7	51.7	48.1	52.0	46.5	45.6	45.7	42.2	33.8	46.1	28.6	22.1	193.564
3196.3	50.6	51.7	52.0	52.9	51.8	48.5	51.7	46.2	45.5	45.7	42.2	34.2	46.4	28.9	22.4	1.802
3256.3	49.5	51.8	51.9	53.0	52.1	48.6	51.8	46.7	45.7	45.8	42.7	33.3	46.5	28.9	22.3	5.627
3279.7	49.2	50.7	51.8	53.1	52.0	48.5	51.7	46.3	45.7	45.9	42.8	34.1	46.8	29.2	22.4	7.134
3339.7	50.9	52.0	52.2	53.5	52.6	49.0	52.5	46.8	46.2	46.3	43.0	34.1	47.3	29.2	22.6	11.030
3362.6	51.1	52.5	52.9	54.0	52.9	49.2	53.0	47.3	46.1	46.7	43.4	34.2	47.4	29.2	22.3	12.532
3422.6	50.4	53.4	53.9	55.3	54.2	50.3	53.9	48.0	47.2	47.3	43.9	34.1	48.1	29.3	22.6	16.338
3482.7	52.4	54.3	54.9	56.2	55.1	51.2	55.6	49.2	48.0	48.6	44.7	34.4	49.2	29.6	22.7	20.211
3505.7	53.1	54.7	55.2	56.4	55.4	51.5	55.7	49.3	48.5	48.8	44.9	34.1	49.3	29.5	22.6	21.661
3565.7	54.3	55.8	56.4	57.4	56.5	52.6	56.6	50.3	48.7	49.7	45.4	34.3	50.7	29.7	22.7	25.523
3588.6	54.7	56.0	56.4	57.9	56.8	52.8	57.0	50.2	49.6	50.0	45.5	34.9	50.5	29.8	22.8	27.011
3648.6	55.6	57.2	57.7	59.0	58.1	53.7	58.4	51.5	50.3	50.8	46.6	35.6	51.5	30.6	22.9	30.799
3708.6	56.6	58.0	58.6	59.[illegible]	58.9	54.2	58.9	51.8	51.1	51.4	46.8	35.1	52.3	30.3	23.0	34.626
3768.7	57.3	59.0	59.2	60.6	59.6	55.6	60.0	52.6	51.7	52.0	47.5	35.7	52.6	30.6	23.0	38.414
3828.7	56.9	59.7	60.0	61.4	60.7	56.5	60.8	53.4	52.5	52.5	48.1	36.6	53.3	31.0	23.2	42.129
3888.7	58.7	60.5	61.0	62.1	61.3	56.6	61.2	53.4	52.7	53.2	48.6	36.7	53.9	30.9	23.2	45.900
3911.6	57.7	61.0	61.4	62.7	61.6	57.4	61.6	54.2	53.2	53.5	48.8	36.9	54.3	31.4	23.4	47.370
3971.7	59.6	61.5	61.9	63.3	62.4	58.4	62.4	54.4	53.6	54.3	49.5	37.1	54.3	31.5	23.3	51.109
3995.1	60.1	61.8	62.3	63.5	62.4	58.5	62.5	54.3	53.8	54.1	49.9	36.8	55.0	31.2	23.4	52.585
4055.0	60.9	62.9	63.2	64.5	63.4	59.3	63.5	54.4	54.4	54.8	50.2	37.8	55.5	32.2	23.6	56.381
4115.1	60.6	63.2	63.7	65.1	64.1	59.5	64.1	55.9	54.9	55.2	50.4	37.6	55.9	32.3	23.5	60.140
4175.1	62.0	63.9	64.5	65.7	64.7	60.3	64.9	56.1	55.6	55.9	51.0	38.5	56.2	32.6	23.6	63.833
4198.5	62.3	64.3	64.8	66.0	65.0	60.8	64.8	56.5	55.4	55.9	51.2	38.4	56.7	32.8	23.7	65.280
4258.5	62.7	64.6	65.4	66.6	65.5	60.9	65.[illegible]	56.8	56.5	56.6	51.6	38.8	57.0	33.0	23.8	69.009
4318.5	63.6	65.4	65.8	67.1	66.1	61.7	66.1	57.5	56.8	56.9	52.1	39.4	57.7	33.1	23.8	72.728
4378.6	63.9	65.9	66.3	67.6	66.5	62.0	66.5	57.5	57.5	57.4	52.5	39.2	57.8	33.6	24.2	76.380
4438.6	64.4	66.2	66.3	68.0	67.0	62.6	66.9	58.0	57.3	57.6	52.5	38.9	58.3	33.7	24.0	80.063
4498.6	64.9	66.6	66.8	68.2	67.0	62.5	67.0	57.8	57.6	58.1	52.8	39.0	58.7	33.8	24.2	83.734
4558.7	64.6	67.0	67.2	68.4	67.2	62.4	66.9	58.4	57.7	57.8	52.9	39.1	59.1	33.7	24.2	87.320
4618.7	64.9	67.0	66.8	68.9	67.4	62.9	67.5	58.7	57.6	54.8	53.7	41.3	59.1	34.2	24.2	90.930
4678.7	65.7	67.4	67.6	69.2	68.1	63.1	67.9	58.5	60.0	58.3	53.5	40.4	59.5	34.0	24.6	94.539
4738.8	64.7	67.8	68.2	69.7	68.6	63.0	68.5	58.5	61.4	58.5	54.1	40.2	58.6	34.1	24.5	98.074
4798.8	65.9	67.7	68.2	69.7	68.7	63.6	68.7	59.4	60.1	59.1	54.5	41.2	59.8	34.8	24.8	101.668
4822.1	66.7	68.1	68.8	69.9	68.6	63.7	68.7	59.4	59.9	59.2	54.2	40.2	60.0	34.5	24.7	103.067

4882.2	66.9	68.4	68.6	70.1	69.0	64.0	68.9	60.1	60.2	59.5	55.0	41.6	60.3	34.8	24.8	106.663
4942.2	66.7	68.6	69.1	70.6	69.2	64.4	69.3	60.1	60.1	59.6	54.9	41.0	60.7	35.1	25.0	110.253
5002.2	67.0	69.2	69.2	70.9	69.8	64.5	69.2	60.6	61.2	60.2	55.0	40.6	60.3	35.4	25.1	113.794
5062.3	67.2	69.2	69.4	71.3	70.0	64.8	69.5	60.8	60.1	60.2	55.0	41.5	60.9	35.5	25.1	117.406
5122.3	67.9	69.7	69.9	71.1	69.9	65.2	69.8	60.9	61.0	60.6	55.3	41.9	61.4	35.3	25.3	121.027
5182.3	68.0	69.7	69.6	71.5	70.2	64.9	70.4	60.9	61.5	60.6	55.6	41.3	60.9	35.4	25.4	124.561
5242.4	68.3	70.0	70.0	71.5	70.3	65.3	70.2	61.2	60.9	60.7	55.6	41.2	61.4	35.6	25.4	128.142
5302.4	68.2	70.0	70.3	71.7	70.4	65.3	70.2	61.1	60.6	60.6	55.7	41.4	61.7	35.9	25.5	131.716
5362.4	68.3	70.3	70.4	72.1	71.0	65.4	70.2	61.2	61.2	61.1	55.9	41.9	61.9	36.0	25.5	135.232
5422.5	68.8	70.3	70.3	71.6	70.6	65.8	70.6	61.6	61.2	60.9	56.1	42.1	62.1	36.3	25.6	138.778
5482.5	68.8	70.7	70.9	72.3	70.7	66.0	70.9	61.5	61.5	61.4	56.3	42.1	62.6	36.1	25.8	142.369
5542.5	69.0	70.9	70.9	72.4	71.2	66.5	70.6	62.2	61.6	61.7	56.4	42.4	62.3	36.2	25.9	145.957
5602.6	69.3	71.0	71.2	72.7	71.4	66.2	71.0	62.0	61.6	61.7	56.6	41.8	62.7	36.3	25.8	149.517
5662.6	69.2	71.3	71.6	73.0	71.7	66.6	71.4	62.1	61.8	61.5	56.4	41.5	62.8	36.5	26.2	153.103
5722.6	69.7	71.4	71.7	72.8	71.5	66.5	71.4	62.5	61.7	61.8	56.5	42.1	62.8	36.7	26.5	156.663
5782.7	69.8	71.5	71.9	73.1	71.8	66.8	71.6	62.4	62.3	61.9	56.8	42.4	62.9	36.7	26.2	160.162
5842.7	70.3	71.7	72.0	73.2	72.0	66.9	71.7	62.6	61.6	62.0	56.8	42.7	63.3	36.7	26.2	163.711
5902.7	68.8	71.3	71.4	72.9	71.3	67.0	71.4	62.7	61.9	61.4	56.8	41.7	62.7	36.4	26.3	167.228
5925.9	69.9	71.6	71.8	73.2	71.9	66.8	71.6	62.7	61.7	61.8	57.0	42.4	63.2	37.0	26.5	168.545
5949.3	70.3	71.8	71.9	73.4	72.1	67.1	71.3	63.0	62.4	62.1	57.3	42.7	63.0	36.9	26.4	169.915
6009.3	70.0	71.9	71.8	73.4	72.1	67.1	72.1	63.0	62.4	62.3	57.2	42.5	63.2	37.2	26.5	173.453
6069.3	70.5	72.2	71.9	73.4	71.7	67.1	71.8	63.0	62.2	62.1	57.1	42.6	63.1	37.3	26.5	176.997
6129.4	70.1	71.8	71.9	73.6	72.0	66.9	71.6	63.1	62.4	62.2	57.2	43.1	63.4	37.1	26.4	180.549
6189.4	70.5	72.1	72.1	73.8	72.6	67.4	72.0	63.4	62.4	62.3	57.5	42.5	63.7	37.2	27.0	184.035
6249.4	70.5	72.6	72.8	74.1	72.6	67.4	72.4	63.2	62.9	62.2	57.3	41.9	63.5	37.4	27.0	187.570
6309.5	71.0	72.6	72.4	74.0	72.6	67.6	72.2	63.4	62.4	62.3	57.2	42.2	63.5	37.1	26.7	191.084
6369.5	70.8	72.6	72.5	74.3	72.8	67.4	72.6	63.2	62.9	62.7	57.5	43.3	63.7	37.7	27.0	194.549
6429.5	70.9	72.6	72.6	74.1	72.7	67.5	72.0	63.3	62.3	62.5	57.5	42.9	64.1	37.4	27.0	198.015
6489.6	70.7	72.5	72.6	73.9	72.4	67.5	72.3	63.2	62.7	62.4	57.5	42.6	63.8	37.6	27.3	201.500
6549.6	70.9	72.6	72.6	74.2	72.8	67.5	72.4	63.4	62.7	62.4	57.6	43.1	63.8	37.5	27.3	3.727
6609.6	70.6	72.4	72.6	74.3	72.6	67.4	72.5	63.7	62.9	62.7	57.5	43.0	63.9	37.5	27.2	7.195
6669.7	70.5	72.5	72.7	74.4	73.0	67.5	72.6	63.5	63.0	62.8	58.0	43.7	63.7	37.4	27.2	10.692
6729.7	70.3	72.5	72.6	74.2	72.8	67.6	72.7	63.7	62.9	63.2	57.8	42.9	64.2	37.3	27.3	14.136
6789.7	70.9	72.7	72.6	74.2	72.9	67.5	72.4	63.5	62.9	63.0	58.1	43.6	64.5	37.8	27.4	17.636
6849.8	70.4	72.4	72.5	74.1	72.8	67.3	72.3	63.5	62.7	62.4	57.5	43.0	64.0	37.8	27.7	21.128
6909.8	71.0	72.8	72.8	74.1	72.8	67.5	72.3	63.6	62.9	62.5	57.8	42.7	64.0	37.7	27.7	24.575
6969.8	70.9	72.6	73.1	74.1	72.8	67.7	72.8	63.8	63.1	63.0	57.7	42.8	64.1	37.8	27.7	27.998
7029.9	71.0	73.1	72.9	74.5	73.0	67.7	72.6	63.3	63.1	63.0	57.9	43.2	64.3	38.1	27.9	31.485
7089.9	70.9	72.9	72.8	74.1	72.9	67.7	72.6	64.0	63.1	63.4	58.1	44.2	64.3	38.1	27.8	34.989
7149.9	71.1	72.9	72.9	74.6	73.1	68.0	73.3	64.1	63.4	63.2	58.2	43.9	64.5	38.4	28.1	38.449
7210.0	70.2	71.6	71.5	72.8	71.6	66.4	71.3	62.9	61.9	61.3	57.2	43.6	63.1	38.1	28.0	41.943
7270.0	68.4	69.7	69.2	70.0	68.9	64.4	68.9	60.8	60.3	59.9	56.0	42.9	60.9	38.0	27.9	45.426
7293.1	67.8	68.8	68.3	69.4	68.1	63.5	67.8	60.3	59.7	58.8	55.3	43.0	60.4	38.3	28.2	46.781
7353.1	65.4	66.4	65.9	67.0	65.5	60.9	65.2	58.3	57.8	57.2	54.3	42.8	58.7	37.6	28.1	50.228
7376.0	63.0	65.0	64.1	65.8	64.4	59.7	64.1	57.8	57.1	56.4	53.7	42.4	58.1	37.8	28.0	51.586
7399.3	63.1	64.6	64.0	65.1	63.6	58.4	63.3	56.3	55.7	55.5	55.1	41.7	56.6	37.6	28.4	52.886
7459.3	61.7	62.2	61.7	62.6	60.9	56.3	60.5	54.7	53.8	53.5	53.8	41.1	54.7	37.6	28.4	56.350
7482.3	60.2	61.6	60.8	61.7	60.2	55.7	59.7	53.9	53.3	53.2	53.4	40.8	53.8	37.6	28.3	57.655
7505.5	59.7	60.5	59.9	60.6	59.2	55.0	59.3	53.6	52.6	52.8	52.9	40.1	53.3	37.2	28.4	59.042
7565.5	57.8	58.5	58.0	58.7	54.9	54.2	55.5	52.7	51.9	50.9	52.2	39.6	52.5	36.2	28.3	62.749

7588.5	[illegible]	57.9	57.7	58.1	54.6	53.8	55.0	52.5	51.7	50.8	52.0	39.8	52.2	36.2	28.3	64.227
7648.[illegible]	55.5	56.0	55.7	56.1	52.7	52.2	53.2	51.1	50.0	49.4	50.6	38.8	50.9	33.9	28.3	68.033
7671.8	55.4	55.6	55.0	55.7	52.5	51.8	52.7	50.7	49.8	48.6	50.0	38.4	50.4	34.0	28.4	69.548
7731.8	53.0	53.9	53.1	54.0	51.2	50.5	51.2	49.4	48.2	47.9	48.6	38.1	49.1	34.9	28.3	73.492
7754.8	52.7	53.2	52.7	53.5	50.8	50.0	50.7	48.9	48.2	47.4	48.3	37.8	48.6	35.4	28.5	74.952
7814.9	51.5	51.8	51.7	51.9	49.8	48.9	49.4	47.6	47.0	46.2	47.2	36.9	47.3	35.0	28.3	78.919
7837.8	50.8	51.2	51.0	51.4	49.1	48.2	48.8	47.0	46.4	45.8	46.6	36.8	46.8	35.0	28.7	80.447
7897.8	49.6	49.9	49.7	50.0	48.5	48.4	48.3	47.3	46.7	45.1	46.8	36.3	41.4	35.0	28.5	84.341
7921.1	49.1	49.4	49.0	49.7	48.2	48.1	47.8	47.1	45.9	44.7	46.2	36.4	36.9	35.1	28.5	85.884
7981.2	47.7	48.3	47.9	48.3	47.0	45.5	46.3	44.7	44.1	43.8	44.3	36.1	44.5	34.5	28.4	89.840
8004.1	47.3	47.8	47.7	48.0	46.8	45.5	46.0	44.5	43.3	43.6	43.7	36.0	44.2	34.6	28.3	91.316
8064.2	46.3	46.5	46.4	46.9	45.1	44.5	44.8	43.5	42.9	42.5	43.1	26.4	43.2	34.3	28.4	95.301
8087.1	46.1	46.1	45.9	46.3	44.7	44.3	44.6	43.4	42.2	42.2	42.4	21.6	43.0	34.0	28.6	96.834
8147.1	44.9	45.2	44.8	45.4	44.0	44.3	44.0	43.4	42.6	41.5	42.8	34.6	37.5	34.0	28.4	100.757
8170.4	44.2	44.8	44.6	45.0	44.0	44.0	43.8	43.3	42.0	41.2	42.4	34.3	32.6	33.7	28.2	102.304
8230.4	43.6	43.7	43.5	44.1	42.9	43.0	43.0	42.2	41.5	40.5	41.7	34.5	24.2	33.5	28.1	106.281
8290.5	42.5	42.9	42.6	43.1	42.2	42.3	42.0	41.6	40.4	39.8	40.8	33.9	38.8	33.3	28.3	110.271
8313.8	42.2	42.6	42.3	42.8	41.7	41.8	41.8	41.0	40.4	39.7	40.7	33.4	36.1	32.9	28.1	111.764

Grooved Plate Dryout Experiment Data Sheet Date: 24 Sep 92 Time: 1322 Run Designation: G3E2				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			Δt=W-C=1.7 - 1.4 min = 0.3 min Δt=W-C=2min40sec-2.4=16 sec groove is plugged but full M_{dot}~0.063 gm/sec	
C6.4	2.430	28.39	Power on search for $Q_{c,max}$	
C13.9	2.430	28.45	Emptied flask	
C47.2			Removed toothpick. Had to clean bluish powder from groove. groove easily refilled	
C52.6	2.423	28.42	power check	
C64.4			Emptied flask	
C66.4	2.609	30.60	Increasing power. Fairly steady state T_l=62	0
C105.3	2.781	32.67	Upped power some more. groove is still wet although meniscus is depressed. I'm going to a reading for power used in G3E1 to see if a similar dryout occurs. Fluid seems clear!	
C113.5			Dryout has begun. T_l=71	5cm
C116.5	2.677	31.41	Powered down a little!	
C119.5	2.675	31.40	Note: M_{dot} to groove higher then in similar case for G3E1	
C139.5	2.677	31.44		4.0
C144.5			Drop in T_0 & T_l due to squirt in end of groove. Checking to see where it rewets to	
C154.3	2.677	31.42	Groove has rewet! I'm convinced this is about where $Q_{c,max}$ is T_l=71 C	
C156.3	3.061	35.95	Upped power	
C183.7			Emptied flask T_l=81 C	

Grooved Plate Dryout Experiment Data Sheet Date: 24 Sep 92 Time: 1322 Run Designation: G3E2				
Runtime (min)	Amps	Volts	Comments	Dryout Length
C184.7			Boiling occurring at front T_7=75 C	32
			Boiling occurring at front with boiling no definite front is available	31
C196.7			I squirted some alcohol in at frort. The excess boils off quickly	
C198.7			Vigorous boiling from 31 cm to 35.6 cm. Front at T_7=78 C Seems to be very stable boiling front	31
C202.7			T_7=80 C note change in M_{dot} thin film followed by nucleate boiling followed by surface waves caused by bubble agitation	
C207.7			I swabbed the front. It reappeared. very stable, consider this steady state	
C209.7			Power down to zero T_7=79.6	31
W211.6			T_6=81.5	26
W212.0				22.0
W212.9			T_4=80.6	16
W213.3				14
W213.7			T_3=77.9	12
W214.1				10
W214.4			T_2=75.7	8
W214.9				6
W215.2			T_1=73.2	4
W215.45				2

Grooved Plate Dryout Experiment Data Sheet

Date: 24 Sep 92 Time: 1322 Run Designation: G3E2

Runtime (min)	Amps	Volts	Comments	Dryout Length
W215.9			Rewet T_0=71.3	0
C218.4	3.071	36.04	Powered back up Note: If anything the boiling which persisted until front movement underway helped push things along. Boiling died out within front movement of 4 cm	
C242.0	3.059	36.00	Emptied flask T_1=78	19
C255	3.060	35.98	Boiling between 28 - 35 cm although fluid extends to 26 cm T_7=76	
C264			I was able to swab away non boiling fluid in font of boiling front. Note: T_7 is now 80 C. Boiling front between 28 - 35 cm	28
C267			Boiling front now at extending to 34.6	29
C273.0	3.058	35.95	Stable boiling front extends from 31 to 35 cm with sputtering fluid up to 29 cm call this steady state	
C276	2.613	30.70	Power curtailed Δt=276.3-276	
W277.0			T_7=80.0B	31
W277.8			B	30
W278.2			B	28
W278.5			T_6=81.9C B	26
W279.3			By shining flashlight directly B	24
W279.9			Down on groove I see	22
W280.7			hump of fluid I'll call T_5=B	20
W282.0			Front	18

Grooved Plate Dryout Experiment Data Sheet Date: 24 Sep 92 Time: 1322 Run Designation: G3E2				
Runtime (min)	Amps	Volts	Comments	Dryout Length
W283.3			T_4=79.0	16
W285.1				14
W287.1			T_3=77.9	12
W289.8				10
W292.7			T_2=74.8	8
W295.4	2.613	30.71		6
W298.1			T_1=71.8	4
W303.0				2
W308.1			Rewet. Problems Identifying front on curved end. T_0=68.0	6
C309.2			Shutdown	

RUN LETTER DESIGNATION: G3E2
DATE: 09-24-1992 TIME: 13:27:58
GROOVE NUMBER: 3
THE RELATIVE HUMIDITY IS 29.242 MM OF MERCURY
THE FLOWMETER SETTING IS : 25
THE PLATE ANGLE IS 0 SCALE IN GRAMS; T15 = 21 C

TIME(s)	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	SCALE
60.4	20.5	20.4	20.6	20.6	20.1	20.6	20.3	20.5	19.3	20.0	20.1	18.3	19.5	18.5	20.4	39.851
83.5	20.6	20.3	20.6	20.7	20.1	20.4	20.4	20.6	19.4	20.1	19.7	18.2	19.8	18.4	20.1	41.401
143.5	20.5	20.3	20.5	20.6	20.1	20.6	20.4	20.5	19.2	20.0	19.9	18.3	19.9	18.6	20.5	45.546
203.6	20.6	20.3	20.5	20.6	20.1	20.3	20.3	20.3	19.5	19.8	20.1	18.4	19.6	18.7	20.1	49.699
263.6	20.5	20.4	20.5	20.7	20.2	20.5	20.4	20.6	19.4	20.0	20.0	18.8	19.8	19.1	20.4	53.784
323.6	20.6	20.3	20.4	20.6	20.0	20.4	20.5	20.4	19.4	20.0	19.9	19.3	19.9	19.4	20.4	57.865
383.7	20.6	20.3	20.5	20.6	20.1	20.5	20.5	20.6	19.5	20.0	19.9	19.1	19.8	19.6	20.4	61.918
443.7	20.8	20.7	21.1	21.2	20.6	20.6	20.9	20.9	19.7	20.4	20.5	19.3	20.1	19.6	20.2	65.951
503.7	22.1	22.2	22.9	23.2	22.7	22.6	22.9	22.7	21.7	22.0	21.5	19.7	21.6	19.8	20.3	69.959
527.1	22.6	23.0	23.8	24.1	23.6	23.4	23.5	23.2	22.3	22.9	22.0	19.9	22.5	19.6	20.4	71.546
587.0	24.6	25.1	25.9	26.5	26.0	25.4	26.1	25.4	24.6	24.8	23.2	20.6	24.1	20.0	20.1	75.630
610.1	25.3	25.9	26.8	27.2	26.9	26.2	26.7	25.7	25.1	25.3	23.9	20.8	24.9	20.0	20.1	77.165
670.1	27.4	27.9	28.8	29.4	29.1	28.0	28.8	28.0	26.8	27.2	25.0	21.6	26.5	20.5	20.3	81.254
693.1	28.1	28.8	29.7	30.2	29.9	28.9	29.6	28.4	27.6	27.7	25.6	22.0	27.2	20.5	20.3	82.829
753.1	30.1	30.7	31.8	32.2	31.8	30.8	31.6	30.4	28.9	29.3	26.8	22.6	28.4	20.8	20.2	86.863
776.4	30.7	31.4	32.4	33.0	32.5	31.0	32.4	30.8	29.8	30.1	27.2	23.0	29.2	21.1	20.2	88.450
836.4	32.6	33.2	34.4	34.7	34.3	32.7	34.2	32.3	31.4	31.1	28.6	23.9	30.1	21.5	20.2	3.370
859.5	33.3	33.9	34.9	35.5	34.9	33.2	34.9	33.0	32.2	31.8	28.9	24.2	30.6	21.6	20.4	4.873
919.4	35.1	35.6	36.8	37.2	36.7	34.7	36.8	33.9	32.7	33.0	30.0	25.1	31.9	22.0	20.2	8.937
942.4	35.5	36.4	37.5	38.0	37.5	35.0	37.8	34.7	33.3	33.5	30.7	25.4	32.3	22.3	20.4	10.514
1002.4	37.2	37.9	39.1	39.6	39.0	36.3	39.3	36.0	34.7	34.8	31.4	26.0	33.4	22.6	20.4	14.531
1025.7	37.8	38.5	39.7	40.1	39.5	36.9	40.0	36.1	35.3	35.2	32.0	26.4	34.2	22.9	20.4	16.124
1085.7	39.0	40.2	41.2	41.6	40.8	38.4	41.5	37.4	36.6	36.3	33.0	27.0	35.0	23.5	20.3	20.212
1108.8	39.6	40.7	41.9	42.3	41.8	38.7	42.0	38.1	36.7	36.7	33.5	27.4	35.4	23.7	20.4	21.741
1168.8	41.1	42.1	43.1	43.7	42.8	39.6	43.2	39.0	37.7	37.7	34.4	27.9	36.9	24.1	20.2	25.854
1191.7	41.6	42.4	43.6	44.1	43.1	39.6	43.5	39.0	38.3	38.1	34.4	28.2	37.1	24.3	20.3	27.441
1251.7	42.9	43.9	45.1	45.5	44.5	41.4	44.8	40.4	38.9	39.2	35.5	28.9	38.2	24.8	20.4	31.486
1275.0	43.2	44.3	45.5	45.8	44.9	41.5	45.3	41.1	39.6	39.8	35.9	29.2	38.6	25.0	20.3	33.083
1335.1	44.4	45.5	46.4	46.8	46.2	42.6	46.3	41.8	40.4	40.4	36.7	29.8	39.4	25.3	20.4	37.212
1358.1	44.7	45.8	47.1	47.4	46.7	42.9	46.7	41.8	41.2	40.7	37.1	30.0	39.9	25.6	20.3	38.757
1418.1	46.0	46.8	48.2	48.4	47.5	43.9	47.8	43.0	41.6	41.7	37.8	30.8	40.5	26.1	20.6	42.899
1441.0	46.1	47.2	48.7	48.8	47.9	44.0	48.2	43.4	42.3	41.9	38.1	30.9	40.9	26.4	20.4	44.503
1501.0	47.3	48.0	49.6	49.8	48.8	44.9	48.9	43.9	42.9	42.8	38.8	31.3	42.0	26.6	20.7	48.589
1524.3	47.5	48.7	49.9	50.2	49.3	45.2	49.4	44.1	43.1	43.0	39.3	31.7	42.8	27.0	20.5	50.202
1584.4	48.5	49.6	51.1	51.3	50.5	46.0	50.4	45.5	44.1	43.8	40.0	32.2	43.3	27.4	20.8	54.366
1607.4	49.1	50.0	51.2	51.5	50.6	46.6	50.6	45.3	44.4	44.0	40.0	32.2	43.8	27.5	20.6	55.919
1667.4	49.7	50.9	52.3	52.6	51.7	47.1	51.8	46.0	45.0	44.9	40.9	32.8	45.0	27.9	20.9	60.097
1727.4	50.5	51.7	53.1	53.3	52.2	47.4	52.4	46.4	45.9	45.5	41.3	33.1	45.9	28.2	20.8	64.287
1787.4	51.4	52.5	53.7	54.0	52.8	48.4	53.1	47.5	46.3	46.3	42.0	33.8	46.5	28.7	20.9	68.418
1847.5	52.2	53.1	54.6	54.7	53.9	48.9	53.9	47.5	47.1	47.1	42.6	34.2	47.8	29.2	20.9	72.617
1907.5	52.8	53.9	55.3	55.5	54.4	49.6	54.7	48.5	47.6	47.5	43.1	34.6	48.1	29.3	20.9	76.834
1967.5	53.1	54.6	56.1	56.4	55.3	49.9	55.1	48.8	48.4	47.9	43.6	34.6	48.8	29.6	21.0	81.060

2027.6	54.2	55.4	56.8	57.1	56.1	50.7	56.0	49.7	48.9	48.7	44.5	35.5	49.5	30.0	21.1	85.233
2050.9	54.4	55.6	57.1	57.3	56.0	50.8	56.2	49.8	49.1	48.9	44.5	35.4	49.5	30.3	20.9	86.877
2110.9	54.9	56.4	57.7	57.9	56.9	51.7	56.9	50.4	49.6	49.4	45.2	36.1	50.3	30.6	21.4	91.122
2170.9	55.4	56.8	58.4	58.6	57.6	52.1	57.6	50.9	49.8	50.1	45.8	36.6	50.7	30.9	21.4	95.353
2231.0	56.1	57.4	58.9	59.0	57.9	52.5	57.9	51.6	50.7	50.5	46.1	36.5	51.3	31.1	21.4	99.518
2291.0	56.3	57.9	59.6	59.6	58.4	53.1	58.4	51.8	51.1	51.1	46.6	37.4	51.7	31.9	21.5	103.749
2351.0	56.9	58.4	59.8	60.0	58.8	53.6	59.3	52.4	51.5	51.3	47.1	37.4	52.3	31.7	21.6	107.976
2411.1	57.5	58.9	60.4	60.7	59.4	54.2	59.6	52.8	51.8	51.9	47.4	37.6	52.7	32.2	21.6	112.141
2471.1	58.1	59.2	60.8	61.0	59.9	54.6	60.0	52.9	52.4	52.5	47.8	38.3	53.3	32.5	21.8	116.377
2531.1	58.7	59.8	61.3	61.6	60.6	55.0	60.4	53.8	52.6	52.7	48.2	38.5	53.4	32.6	22.1	120.601
2591.2	58.7	60.1	61.7	61.9	60.6	55.2	60.8	53.8	53.2	53.0	48.5	38.5	53.8	32.7	22.0	124.762
2651.2	58.9	60.7	62.2	62.3	61.4	56.0	61.2	54.4	53.4	53.3	49.0	38.9	54.3	33.2	22.2	128.970
2711.2	59.5	60.8	62.4	62.6	61.3	55.9	61.6	54.6	53.8	53.5	49.4	39.5	54.7	33.5	22.1	133.202
2771.3	59.8	61.1	62.9	63.0	61.8	56.5	61.7	54.9	54.1	54.1	49.7	39.3	55.0	33.8	22.4	137.416
2831.3	60.2	61.6	63.1	63.4	62.2	56.6	62.4	55.0	54.3	54.3	50.0	39.5	55.3	34.1	22.5	141.546
2891.3	60.6	62.0	63.3	63.5	62.5	56.8	62.8	55.4	54.8	54.4	50.2	39.6	55.6	33.9	22.3	145.591
2951.4	59.6	61.1	62.4	62.9	61.8	56.6	62.2	55.1	53.9	54.0	49.9	40.6	55.2	33.8	22.6	149.403
2974.6	59.6	61.3	62.6	63.0	61.8	56.9	62.2	55.2	54.4	54.1	50.1	41.0	55.0	33.8	22.5	150.769
3034.6	58.7	59.8	60.6	61.9	60.8	56.5	61.0	55.1	54.1	54.4	50.0	39.6	54.7	34.2	22.6	154.442
3094.6	58.2	60.4	61.8	62.6	61.7	56.3	61.0	54.7	53.6	52.2	49.9	38.2	54.7	32.4	22.7	158.010
3154.6	58.3	60.2	60.9	61.9	60.8	56.5	60.8	55.0	53.5	51.6	49.8	35.9	54.4	31.9	22.9	161.532
3214.7	60.1	61.6	63.1	63.1	62.1	56.8	61.9	55.4	54.5	53.3	50.2	38.8	55.2	32.9	23.0	164.994
3238.0	60.3	61.6	63.1	63.3	62.0	56.9	62.1	55.4	54.3	53.9	49.9	39.1	55.2	33.3	22.9	166.361
3298.0	60.7	61.8	63.3	63.3	62.1	56.6	62.2	55.5	54.4	54.3	50.2	38.8	55.5	33.7	23.3	169.888
3358.0	60.4	61.8	63.1	63.3	61.8	56.9	62.0	55.1	54.5	53.8	49.8	38.7	54.8	33.9	23.2	173.343
3418.1	60.6	61.8	63.4	63.5	62.1	56.8	62.0	55.7	54.3	54.4	50.4	39.7	55.5	34.1	23.4	176.870
3478.1	60.8	61.9	63.3	63.7	62.4	56.6	62.2	55.6	54.8	54.4	50.1	40.2	55.5	34.4	23.5	180.411
3538.1	60.5	62.2	63.3	63.7	62.4	57.2	62.3	55.8	54.6	54.5	50.2	39.8	55.7	34.6	23.4	183.970
3598.2	60.8	62.1	63.6	63.7	62.6	57.4	62.6	56.2	55.3	54.8	50.4	40.1	55.7	34.8	23.5	187.484
3658.2	60.4	62.2	63.3	63.3	62.1	57.2	62.2	55.7	54.6	54.5	50.3	39.8	55.4	34.1	23.7	191.029
3718.2	59.5	61.8	63.6	63.7	62.3	57.0	62.4	55.8	54.8	54.7	50.5	40.5	55.7	34.9	23.7	194.579
3778.3	60.9	62.2	63.6	63.5	62.2	57.2	62.4	55.6	54.7	54.7	50.4	39.9	56.0	34.8	23.7	198.055
3801.6	61.0	62.3	63.5	63.7	62.5	57.3	62.7	56.0	55.3	54.4	50.4	40.1	55.4	34.9	23.9	199.420
3861.6	61.0	62.2	63.4	63.4	62.2	57.2	62.2	55.9	55.1	54.7	50.4	39.6	55.5	34.7	23.9	2.992
3921.7	60.6	62.2	63.5	63.5	62.5	57.4	62.5	56.0	54.6	54.7	50.6	39.9	55.7	34.8	24.1	6.490
3981.7	60.8	62.4	63.7	63.8	62.7	57.5	62.7	55.8	55.3	55.0	50.9	40.7	55.9	35.3	24.1	9.964
4041.7	60.9	62.6	64.0	64.0	63.0	57.5	63.0	56.0	54.9	55.3	50.7	40.7	56.3	35.5	24.3	13.501
4101.8	61.6	62.6	64.3	64.3	63.2	57.8	63.3	56.6	55.8	55.3	51.2	40.3	56.2	35.5	24.5	17.070
4161.8	61.6	63.2	64.6	64.7	63.7	58.0	63.7	56.9	55.6	55.8	51.4	40.7	56.7	35.6	24.5	20.629
4221.8	62.1	63.3	64.8	65.0	64.2	58.7	64.2	56.9	56.3	56.1	51.7	41.2	57.3	35.3	24.7	24.126
4281.9	62.5	63.7	65.3	65.4	64.4	58.7	64.3	57.5	56.3	56.9	52.1	41.6	57.1	35.9	24.7	27.708
4341.9	62.1	63.9	65.5	65.6	64.6	58.9	64.6	57.6	56.8	56.3	51.8	41.3	57.4	35.3	24.7	31.275
4401.9	63.0	64.2	65.8	65.9	65.0	59.7	64.8	58.0	56.7	56.8	51.9	41.8	57.8	36.2	24.7	34.781
4462.0	62.9	64.7	66.2	66.3	65.2	59.2	65.2	58.3	57.3	57.2	52.4	41.8	58.1	35.7	24.8	38.335
4522.0	63.4	64.8	66.5	66.4	65.3	59.7	65.7	58.3	57.5	57.4	52.7	41.7	58.4	36.0	24.8	41.890
4582.0	63.6	64.9	66.7	67.0	65.6	60.1	65.9	58.7	57.7	57.5	53.0	41.8	58.4	36.6	24.8	45.382
4642.1	63.8	65.5	67.2	67.3	66.1	60.4	65.9	58.6	57.8	57.8	53.2	42.2	58.8	36.4	25.0	48.929
4702.1	64.0	65.6	67.1	67.4	66.1	60.4	65.8	59.0	57.7	57.7	53.1	41.5	58.8	36.3	25.1	52.467
4762.2	62.3	65.9	66.9	67.4	66.2	60.5	66.4	58.9	58.1	57.8	53.2	42.1	59.3	36.6	24.9	55.994
4785.5	63.6	65.9	67.4	67.6	66.4	60.8	66.4	58.8	57.9	58.3	53.3	42.6	59.0	36.3	25.0	57.304

4808.9	64.3	65.9	67.6	67.8	66.5	60.8	66.5	59.2	58.2	58.1	53.5	42.4	59.0	36.7	25.1	58.671
4868.9	64.1	66.1	67.6	67.7	66.4	60.8	66.7	59.0	57.9	58.2	53.5	42.0	59.3	36.6	25.0	62.201
4928.9	64.7	66.6	67.8	68.2	66.7	61.1	66.7	59.8	59.1	58.3	53.6	42.4	59.1	36.5	25.3	65.715
4988.9	65.1	66.4	68.2	68.2	67.0	61.4	66.9	59.7	58.4	58.7	53.9	42.4	59.6	36.7	25.4	69.180
5049.0	64.8	66.7	68.2	68.4	67.1	61.3	67.3	60.1	59.3	58.7	53.9	42.7	59.5	37.0	25.4	72.709
5109.0	65.3	66.8	68.3	68.5	67.1	61.6	67.4	59.9	59.0	58.9	53.8	42.5	59.9	37.1	25.4	76.190
5169.0	65.1	66.9	68.2	68.6	67.4	61.6	67.3	60.1	59.4	59.0	54.1	42.5	59.9	36.8	25.6	79.680
5229.1	65.6	66.9	68.5	68.6	67.4	61.6	67.5	60.1	59.0	58.9	54.1	43.2	59.7	37.2	25.6	83.103
5289.1	65.3	67.0	68.6	68.7	67.7	61.6	67.5	60.0	59.4	58.8	54.3	42.4	59.8	36.9	25.8	86.550
5349.1	65.4	67.2	68.7	69.0	67.8	62.1	67.5	60.3	59.1	59.2	54.2	43.3	60.0	37.2	25.6	89.990
5409.2	65.6	67.3	68.8	69.0	68.0	62.1	67.9	60.6	59.3	59.3	54.3	42.7	60.5	37.0	25.6	93.386
5469.2	65.6	67.5	68.8	69.0	67.9	62.0	68.0	60.6	59.8	59.4	54.7	43.2	60.5	37.2	25.8	96.832
5529.2	65.8	67.8	69.0	69.3	68.0	62.3	68.1	60.6	59.6	59.4	54.8	42.9	60.5	37.4	25.8	100.293
5589.3	66.0	67.6	69.2	69.4	68.1	62.3	68.4	60.7	59.8	59.5	54.7	43.2	60.5	37.0	25.8	103.703
5649.3	65.8	67.6	69.3	69.5	68.0	62.4	68.5	60.8	59.5	59.6	54.7	43.2	60.8	37.2	26.0	107.163
5709.3	66.1	67.8	69.4	69.5	68.0	62.6	68.2	60.9	60.0	59.9	54.7	43.2	60.9	37.3	25.9	110.623
5769.4	66.1	67.8	69.5	69.6	68.0	62.4	68.1	61.0	60.1	59.6	55.0	43.4	60.8	37.4	25.9	114.068
5829.4	66.5	67.8	69.8	69.8	68.8	62.5	68.6	60.9	60.3	59.9	55.2	44.0	60.7	37.6	25.9	117.467
5889.4	66.6	68.0	69.8	70.0	68.7	63.0	68.7	61.6	59.8	59.9	55.1	43.6	60.9	37.5	26.5	120.915
5949.5	65.5	67.8	69.5	69.5	68.0	62.5	67.9	60.5	59.8	59.3	54.8	42.6	60.9	37.2	26.2	124.338
5972.7	63.4	68.1	69.7	69.7	68.7	62.6	68.3	61.0	60.0	59.9	55.0	43.1	61.0	37.7	26.2	125.618
5996.1	64.4	68.0	69.8	70.0	68.6	62.8	68.5	61.2	60.1	59.9	55.2	43.7	61.0	37.7	26.4	126.927
6056.0	66.3	68.3	69.5	69.8	68.6	62.5	68.3	60.8	60.3	59.9	55.0	43.4	60.8	37.5	26.2	130.320
6079.0	66.3	68.1	69.8	69.8	68.4	62.5	68.4	61.0	59.6	59.7	55.2	42.7	60.8	37.5	26.1	131.625
6139.0	66.3	68.3	69.8	69.9	68.4	62.6	68.7	61.2	60.5	59.8	55.2	43.7	60.9	37.5	26.5	134.953
6199.0	66.5	68.4	69.9	70.0	68.8	63.0	68.7	61.4	59.8	60.0	55.3	44.1	61.3	37.6	26.6	138.342
6259.0	66.9	68.5	70.0	70.2	68.9	63.2	68.9	61.3	60.5	60.5	55.4	44.0	61.7	37.7	26.7	141.736
6319.1	66.8	68.4	70.0	69.8	68.6	63.2	68.3	61.3	59.9	59.9	55.4	43.7	61.2	38.0	26.5	145.057
6379.1	66.8	68.6	70.1	70.2	69.0	63.2	69.1	61.3	60.6	60.2	55.5	44.2	61.4	38.0	26.7	148.436
6439.1	67.4	68.8	70.2	70.3	69.2	63.2	69.1	61.8	60.5	60.4	55.5	43.5	61.8	37.7	26.9	151.821
6499.2	64.4	69.2	70.6	70.9	69.6	63.4	69.2	61.8	60.8	60.5	55.9	43.7	61.8	37.9	26.9	155.149
6522.5	65.6	69.2	70.9	70.9	69.4	63.8	69.5	62.0	61.2	60.6	55.9	44.0	61.9	38.0	26.8	156.455
6545.9	66.9	69.3	70.9	70.9	69.2	63.9	69.6	62.1	61.1	60.7	55.8	43.6	62.0	37.9	26.9	157.757
6569.3	67.3	69.3	71.1	71.1	69.9	63.9	70.1	62.1	61.5	61.0	55.9	44.5	62.3	38.0	27.2	159.058
6629.2	67.7	69.8	71.5	71.8	70.5	64.4	70.4	62.6	61.9	61.7	56.5	44.7	62.7	38.4	26.9	162.412
6689.3	68.3	70.1	71.9	72.0	70.8	64.7	70.8	63.1	62.0	61.7	56.5	44.4	62.8	38.1	27.2	165.787
6749.3	68.7	70.3	72.1	72.2	70.8	65.1	71.0	63.0	62.3	61.9	56.7	44.6	62.9	38.5	27.2	169.109
6809.3	68.7	70.7	72.4	72.5	71.2	64.9	71.4	63.2	62.5	62.0	56.9	44.8	63.1	38.4	27.2	172.462
6869.4	69.5	70.9	72.6	72.6	71.1	64.9	71.2	63.3	62.3	61.9	57.1	44.7	63.4	38.5	27.0	175.766
6929.4	69.4	71.4	72.9	73.3	71.6	65.3	71.7	63.6	62.5	62.4	57.2	44.8	63.6	38.4	27.3	179.046
6989.4	69.9	71.5	73.1	73.0	71.8	65.6	71.7	63.7	62.7	62.4	57.5	44.7	63.9	38.7	27.2	182.403
7049.5	69.9	71.8	73.5	73.4	72.2	65.6	71.9	63.6	62.9	62.6	57.5	45.4	64.0	38.6	27.2	185.756
7109.5	70.0	71.8	73.2	73.2	71.9	65.8	71.7	64.0	62.7	62.5	57.3	44.5	63.8	38.7	27.3	2.307
7169.5	70.0	71.8	73.4	73.5	72.0	65.6	71.7	63.5	62.7	62.1	57.1	44.8	63.6	39.0	27.4	5.570
7229.6	69.8	71.7	73.3	73.3	71.9	65.4	71.7	63.8	62.3	62.3	57.5	44.9	63.4	38.6	27.1	8.922
7289.6	69.9	71.6	73.1	73.4	71.7	65.3	71.6	63.2	62.7	62.4	57.3	44.7	63.6	38.9	27.1	12.297
7349.6	69.9	71.7	73.2	73.3	71.9	65.3	71.7	64.0	62.6	62.4	57.4	44.8	63.5	39.1	27.3	15.621
7409.7	69.8	71.6	73.1	73.0	71.6	65.4	71.1	63.6	62.8	62.0	57.0	44.1	63.7	39.0	27.4	19.024
7469.7	69.9	71.7	73.1	73.3	72.1	65.6	71.6	63.9	62.7	62.4	57.4	45.6	63.4	39.0	27.4	22.421
7529.7	69.7	71.4	73.2	73.0	71.9	65.4	71.5	64.0	62.9	62.5	57.2	45.5	63.4	39.0	27.6	25.773

7589.8	69.6	71.4	72.8	72.8	71.2	65.3	71.0	63.5	62.4	61.8	56.9	44.8	63.5	38.4	27.4	29.180
7649.8	69.7	71.1	72.9	73.0	71.5	65.4	71.5	63.9	62.5	62.1	57.2	44.5	63.4	38.7	27.5	32.552
7709.8	70.0	71.7	72.9	73.0	71.6	65.0	71.2	63.2	62.5	61.9	57.2	45.0	63.3	38.5	27.7	35.912
7769.9	69.8	71.6	72.8	73.0	71.3	65.5	71.6	63.2	62.5	62.1	57.0	44.4	63.4	38.9	27.7	39.223
7829.9	70.1	71.7	72.9	73.3	72.0	65.4	71.5	63.7	62.5	62.2	57.1	45.1	63.7	38.7	27.5	42.585
7889.9	69.5	71.4	73.2	73.0	71.4	65.3	71.5	63.8	62.4	62.1	57.4	45.3	63.3	38.9	27.4	45.969
7950.0	69.4	71.3	72.8	72.8	71.3	65.3	71.4	63.4	62.5	62.1	57.1	44.6	64.0	38.9	27.5	49.294
8010.0	69.4	71.2	72.8	72.9	71.3	65.6	71.3	64.0	62.5	62.1	57.3	45.0	63.6	39.0	27.4	52.670
8070.0	69.5	71.5	72.9	73.0	71.3	65.2	71.5	63.5	62.8	62.2	57.2	44.4	63.4	39.0	27.7	56.031
8130.1	69.9	71.5	72.9	73.0	71.9	65.4	71.3	63.8	62.7	62.1	57.2	45.1	63.6	39.2	27.8	59.344
8190.1	69.1	71.0	72.9	72.7	71.0	65.0	71.1	63.4	62.3	61.9	57.2	45.0	63.2	38.7	27.8	62.683
8250.1	69.3	71.3	72.9	72.8	71.1	65.2	71.1	63.1	62.2	61.7	57.0	45.1	63.6	39.2	27.7	66.028
8310.2	69.3	71.1	72.9	72.6	71.3	65.1	71.0	63.3	62.5	61.7	57.1	44.6	63.3	38.8	27.8	69.312
8370.2	69.2	71.1	72.7	72.8	71.3	65.0	71.3	63.5	62.4	62.1	57.2	45.0	63.4	38.4	27.8	72.622
8430.2	69.3	71.1	72.6	72.8	71.5	65.1	71.1	63.6	62.4	62.0	57.1	45.1	63.4	38.8	27.7	75.940
8490.3	68.9	70.9	72.7	72.8	71.1	65.2	71.1	63.4	62.5	62.1	57.1	44.8	63.1	38.7	27.8	79.133
8550.3	69.6	71.2	72.6	72.5	71.1	65.0	71.0	63.6	62.3	62.2	57.2	45.1	63.3	38.8	28.1	82.126
8610.3	69.3	70.9	72.6	72.8	71.4	65.0	71.3	63.5	62.7	62.0	56.9	44.8	63.1	38.9	27.8	85.239
8670.4	66.8	70.3	72.3	72.3	70.8	64.7	70.9	63.3	61.7	61.7	57.0	44.5	63.3	39.0	27.8	88.411
8693.6	68.1	70.6	72.3	72.2	71.0	65.1	70.8	63.3	62.6	61.9	57.0	44.4	63.0	39.0	28.1	89.609
8716.9	68.4	70.4	72.4	72.2	70.8	65.1	70.8	63.2	62.3	61.7	56.8	43.8	62.8	38.9	28.1	90.853
8776.9	68.5	70.4	71.8	72.1	70.6	64.9	70.4	63.0	62.0	62.1	57.0	44.6	63.5	38.6	27.7	94.084
8837.0	69.1	70.6	72.1	72.4	70.8	64.9	71.1	62.9	62.2	61.9	56.9	45.3	63.4	39.0	27.8	97.344
8897.0	68.7	70.6	72.3	72.3	70.7	65.1	70.8	63.6	62.5	61.8	57.0	45.1	63.2	39.1	27.8	100.551
8957.0	69.2	70.6	72.2	72.4	70.9	65.2	70.8	63.3	62.3	61.9	56.9	44.6	63.1	39.1	27.7	103.840
9017.1	69.1	70.6	72.4	72.4	71.0	65.2	70.8	63.5	62.1	61.7	57.1	45.2	62.9	39.0	28.0	107.142
9077.1	69.1	70.9	72.5	72.5	71.1	65.0	71.2	63.3	62.8	62.2	57.2	45.0	63.4	39.2	27.8	110.463
9137.1	69.2	71.1	72.5	72.4	71.3	65.2	71.1	63.6	62.5	62.1	57.4	45.1	63.5	39.0	28.1	113.731
9197.2	69.2	70.8	72.6	72.6	71.1	65.2	71.3	63.7	62.7	62.1	57.2	45.3	63.1	38.9	28.1	117.066
9257.2	68.9	70.9	72.6	72.8	71.2	65.3	71.4	63.7	62.6	62.2	57.3	44.4	63.6	39.5	28.0	120.394
9317.2	69.3	71.1	72.4	72.7	71.3	65.3	71.3	63.5	62.4	61.9	57.1	44.8	63.6	39.0	27.9	123.642
9377.3	69.2	71.0	72.5	72.6	71.1	65.2	71.0	63.0	62.3	62.2	57.2	45.2	63.4	38.9	28.1	126.919
9437.3	68.9	71.0	72.5	73.0	71.1	65.4	71.2	63.3	62.2	62.3	57.2	44.8	63.6	39.0	28.0	130.199
9497.3	69.5	71.6	73.4	73.5	71.9	65.9	72.0	64.3	63.5	62.8	57.6	45.0	63.8	39.0	28.1	133.432
9557.4	70.2	72.2	74.1	74.1	72.8	66.4	72.6	64.8	63.5	63.4	58.0	45.3	65.0	39.0	27.9	136.717
9617.4	70.4	72.8	74.5	74.9	73.2	67.0	73.3	64.7	64.1	63.6	58.2	45.1	65.3	39.0	28.0	139.978
9677.4	71.4	73.4	75.3	75.7	74.0	67.2	73.9	65.9	64.5	64.3	58.8	45.8	65.5	39.4	28.1	143.226
9700.7	71.6	73.8	75.6	75.8	74.2	67.4	74.1	65.7	64.8	64.3	58.7	44.8	65.5	39.4	27.9	144.408
9760.8	72.3	74.4	76.3	76.3	74.8	67.9	74.3	65.9	64.9	64.8	59.2	46.1	66.3	39.5	28.0	147.631
9820.8	72.4	74.9	76.5	76.7	75.2	68.1	75.0	66.1	65.2	65.0	59.5	45.9	66.5	39.5	27.9	150.871
9880.8	73.1	75.3	77.3	77.4	75.8	68.5	75.3	66.7	65.7	65.2	59.6	46.1	66.8	39.9	28.1	154.087
9940.9	73.8	75.7	77.5	77.8	76.1	69.0	75.6	66.7	65.8	65.9	59.7	45.3	67.3	39.3	28.0	157.230
10000.9	73.8	76.1	78.0	78.0	76.2	69.2	75.8	66.9	66.0	65.4	59.8	45.6	67.3	39.6	28.1	160.401
10060.9	74.6	76.6	78.4	78.6	76.9	69.2	76.5	67.4	66.9	65.9	59.9	46.2	67.7	39.6	28.0	163.591
10120.9	75.2	77.2	78.6	78.6	77.4	69.6	76.9	67.6	67.2	66.1	60.3	46.2	67.9	39.8	28.1	166.747
10181.0	75.0	77.2	79.4	79.3	77.6	70.0	77.1	67.9	67.0	66.6	60.7	47.0	68.2	39.6	28.1	169.965
10241.0	75.5	77.6	79.4	79.5	78.3	70.1	77.7	68.2	67.5	66.9	60.7	46.3	68.7	40.0	28.1	173.184
10301.1	76.0	78.0	80.2	80.2	78.4	70.4	77.9	68.4	67.3	66.6	61.2	47.4	68.7	40.1	28.3	176.371
10361.1	76.3	78.5	80.5	80.6	79.2	70.8	78.3	68.8	67.9	66.3	61.2	46.9	68.8	40.1	28.1	179.596
10421.1	76.3	78.5	80.7	80.6	79.2	71.0	78.8	69.1	67.9	66.8	61.1	46.9	69.4	40.5	28.1	182.803

10481.2	76.6	79.1	80.9	80.8	79.1	71.3	78.7	69.1	68.4	67.4	61.6	47.1	69.3	40.3	28.1	185.994
10541.2	77.1	79.2	81.1	81.3	79.5	71.5	78.6	69.3	68.5	67.8	61.6	47.1	69.5	40.4	28.2	189.154
10601.2	77.6	79.6	81.3	81.5	79.9	71.5	79.0	69.3	68.7	67.9	62.3	48.0	69.7	40.6	28.2	192.378
10661.3	77.6	79.6	81.9	81.6	80.1	71.7	79.4	69.8	68.9	68.0	61.8	47.8	69.9	41.2	28.3	195.617
10721.3	77.7	80.2	82.1	82.1	80.3	71.7	79.3	70.7	68.7	68.5	62.3	48.1	70.3	40.9	28.3	198.810
10781.3	78.0	80.3	82.3	82.5	80.6	70.8	79.6	74.2	68.3	68.6	62.5	48.2	68.7	40.6	28.2	202.048
10841.4	78.2	80.5	82.6	82.7	80.8	71.4	80.0	74.6	68.3	68.8	62.8	48.4	69.3	40.9	28.3	205.298
10901.4	78.5	80.8	82.9	82.9	81.0	71.5	80.6	74.6	68.7	69.0	63.0	47.8	69.3	40.7	28.4	208.503
10961.4	79.0	80.8	83.1	82.9	81.4	72.1	80.7	75.1	68.9	69.0	63.0	47.7	69.7	41.2	28.4	211.721
11021.4	79.3	81.3	83.2	83.5	81.6	72.0	80.8	74.5	68.7	68.8	63.0	48.1	69.9	41.2	28.4	2.394
11081.5	79.0	81.5	83.3	83.4	81.8	72.2	80.9	74.6	68.6	69.2	63.1	47.6	70.1	41.2	28.4	5.573
11141.5	79.0	81.5	83.4	83.7	82.1	72.0	80.9	75.1	69.5	69.6	63.4	48.9	69.9	41.4	28.4	8.751
11201.6	79.0	81.6	83.4	83.6	82.1	72.4	81.0	74.9	69.1	69.6	63.0	49.0	70.2	41.4	28.5	11.988
11261.6	79.5	81.7	83.7	83.7	81.7	71.9	81.2	75.0	68.9	69.3	63.5	48.3	69.7	41.6	28.6	15.220
11321.6	79.4	82.0	83.7	83.7	82.3	72.3	81.1	75.0	69.5	69.4	63.3	49.1	70.1	41.7	28.4	18.375
11381.7	79.7	81.9	84.1	84.2	82.4	72.5	81.8	75.5	69.5	69.7	63.8	49.0	70.4	41.7	28.8	21.593
11441.7	80.0	82.1	84.3	84.3	82.7	72.3	81.8	75.5	69.3	70.0	63.7	49.9	70.4	41.8	28.6	24.803
11501.7	80.4	82.1	84.3	84.4	82.6	71.4	82.0	79.3	68.5	69.8	63.8	49.3	69.1	41.5	28.7	27.962
11561.8	79.6	82.3	84.3	84.3	82.9	71.5	81.8	79.3	68.3	69.7	63.5	48.6	69.6	41.7	28.7	31.135
11621.8	79.8	82.5	84.3	84.6	82.9	71.7	81.7	79.4	68.3	69.8	63.9	48.8	69.7	42.0	28.8	34.296
11681.8	80.0	82.3	84.3	84.7	83.0	71.6	81.8	79.6	68.7	69.8	63.5	48.4	69.4	41.5	28.8	37.415
11741.9	80.3	82.5	84.4	84.4	82.9	71.6	82.1	79.3	68.4	70.4	63.8	48.9	69.4	41.4	28.7	40.493
11801.9	80.4	82.8	84.3	84.6	83.0	71.5	81.7	77.7	67.9	69.9	63.8	48.1	69.0	41.9	28.9	43.616
11861.9	80.0	82.5	84.4	84.4	82.5	71.6	82.0	78.9	68.2	70.0	63.8	48.4	69.2	41.8	28.8	46.780
11922.0	80.3	82.6	84.6	84.4	82.5	71.3	81.7	79.1	68.3	70.3	63.9	48.8	69.2	42.0	28.9	49.907
11982.0	80.2	82.3	84.4	84.4	83.1	72.0	82.2	79.3	68.6	70.1	63.6	49.1	69.4	41.5	28.9	53.095
12042.0	80.0	82.2	84.4	84.2	82.4	71.3	81.4	78.5	67.9	69.2	63.2	48.3	69.0	41.2	28.8	56.244
12102.1	80.5	82.6	84.4	84.6	82.7	71.6	82.0	79.4	68.8	70.0	63.8	48.7	69.5	42.1	29.0	59.368
12162.1	80.1	82.4	84.8	84.6	83.2	71.4	81.8	79.6	68.5	69.7	63.9	48.4	69.3	41.7	29.0	62.522
12222.1	80.1	82.4	84.5	84.8	83.2	71.7	81.8	79.3	68.8	70.3	63.8	48.7	69.6	41.6	29.1	65.713
12282.2	80.3	82.3	84.5	84.7	83.1	71.6	82.0	79.6	68.5	70.2	63.8	49.1	69.9	41.4	29.0	68.893
12342.2	80.8	83.1	84.9	85.0	83.1	72.0	82.9	79.7	68.8	70.1	64.1	49.5	69.6	41.8	29.1	72.017
12402.2	80.9	82.8	84.9	85.0	83.4	71.6	82.6	79.6	68.8	70.5	64.1	48.7	70.0	41.9	29.0	75.189
12462.3	80.9	83.0	85.0	85.1	83.6	71.9	82.2	79.6	69.0	70.3	63.9	49.7	69.8	42.1	29.2	78.280
12522.3	80.5	83.2	85.0	85.0	83.0	72.0	82.5	79.7	68.8	70.7	64.1	49.8	70.0	42.2	29.1	81.274
12582.3	80.4	83.2	85.0	85.0	83.4	71.8	82.0	80.0	69.4	70.2	64.3	48.7	69.7	42.2	29.1	84.365
12642.4	80.4	83.0	85.0	84.9	83.2	72.1	82.5	79.9	68.8	70.2	64.1	49.7	69.7	42.3	29.4	87.469
12702.4	79.2	81.0	82.6	82.5	81.1	71.1	80.6	75.5	68.0	68.1	62.7	49.7	69.0	42.1	29.4	90.518
12725.8	78.5	80.3	81.5	81.5	79.9	70.8	79.2	72.9	67.7	67.5	61.9	49.0	69.0	42.4	29.2	91.714
12785.8	76.6	77.5	78.8	78.5	77.0	69.0	75.7	68.3	66.5	64.8	60.6	47.9	67.1	42.1	29.2	94.819
12808.7	75.6	76.7	77.7	77.3	75.6	68.0	74.7	67.6	65.4	64.3	59.8	46.9	66.1	42.0	29.4	96.032
12832.0	74.6	75.7	76.7	76.2	74.3	67.0	73.3	67.1	64.3	63.4	59.4	48.3	65.3	41.7	29.5	97.204
12855.4	73.6	74.5	75.2	74.6	72.8	66.2	72.3	65.8	63.5	62.4	58.6	47.2	64.3	41.5	29.4	98.404
12915.4	71.0	71.6	72.6	72.1	70.3	63.7	69.3	63.9	61.4	60.6	57.2	46.5	61.7	41.6	29.3	101.564
12938.3	70.1	70.8	71.1	70.8	69.0	62.9	68.4	63.1	60.6	59.7	56.3	46.6	60.9	41.4	29.2	102.785
12998.3	65.0	68.0	68.7	68.3	66.5	60.8	65.7	61.1	58.4	58.1	55.1	46.1	58.9	41.1	29.4	105.882
13021.7	63.3	64.5	63.5	66.9	65.1	60.1	64.4	59.9	57.3	56.9	54.0	45.0	58.1	40.7	29.3	107.103
13045.1	63.0	63.5	62.8	65.8	64.2	59.3	63.4	59.0	57.0	56.4	54.0	44.7	57.5	40.4	29.2	108.314
13105.1	62.3	62.8	63.4	63.4	61.9	57.3	61.2	57.5	54.7	54.4	52.4	44.4	55.5	39.8	29.5	111.462
13165.1	60.5	61.3	62.2	61.9	60.3	55.9	59.8	56.3	53.7	53.7	51.7	43.2	54.3	39.8	29.5	114.598

13188.5	59.9	61.1	62.3	62.1	60.5	56.1	60.1	56.5	53.7	54.0	51.5	43.1	54.0	39.4	29.4	115.795
13248.5	60.2	61.7	63.2	63.1	61.6	57.2	61.3	57.8	55.1	55.5	52.1	42.9	55.2	39.0	29.5	119.007
13308.5	61.0	62.6	64.2	64.5	63.2	58.5	63.4	59.2	56.2	56.4	52.8	42.5	56.5	38.9	29.4	122.285
13368.5	62.1	63.7	65.3	65.8	64.4	59.4	64.7	60.3	57.2	57.5	53.5	42.4	57.7	38.5	29.4	125.594
13391.9	62.1	64.0	66.0	66.1	64.9	60.1	65.3	60.9	57.2	58.0	53.8	42.9	58.1	38.3	29.5	126.822
13451.9	63.5	65.1	67.0	67.2	66.0	60.9	66.4	61.7	58.1	58.8	54.6	43.3	58.8	38.2	29.4	130.153
13474.8	63.8	65.6	67.5	67.6	66.3	60.7	66.9	62.1	58.3	59.2	54.7	44.0	59.3	38.6	29.5	131.440
13534.8	64.7	66.6	68.4	68.6	67.7	62.1	68.2	63.4	59.4	60.0	55.2	44.2	60.5	38.6	29.4	134.729
13594.8	65.6	67.7	69.6	69.8	68.6	62.7	69.1	63.7	60.4	60.8	55.9	44.0	61.0	38.6	29.4	138.065
13654.9	66.5	68.6	70.7	70.8	69.6	64.1	70.0	64.7	61.1	61.6	56.5	44.7	62.0	38.7	29.4	141.401
13714.9	67.8	69.6	71.5	71.8	70.5	64.4	71.2	65.1	61.8	62.3	57.2	44.5	62.9	38.9	29.5	144.695
13738.2	68.0	70.0	71.7	72.1	70.8	64.6	71.4	65.6	61.6	62.7	57.4	45.5	62.9	38.6	29.3	145.993
13798.3	69.0	70.8	72.6	72.9	71.5	65.6	72.0	66.1	62.7	63.3	57.8	45.1	63.3	39.1	29.3	149.345
13858.3	69.6	71.6	73.4	73.8	72.5	66.0	73.0	66.9	62.9	63.3	58.2	45.7	64.0	39.3	29.1	152.690
13918.3	70.3	72.5	74.2	74.6	73.2	66.3	73.4	67.1	63.9	63.7	58.5	46.2	64.9	39.6	29.1	155.982
13978.4	71.3	73.3	75.0	75.4	74.1	67.1	74.3	68.0	64.2	64.6	59.0	45.7	65.1	39.7	29.5	159.327
14038.4	71.8	74.0	75.9	76.0	74.6	67.5	74.6	67.9	64.5	64.7	59.2	46.6	66.0	39.6	29.2	162.651
14098.4	72.6	74.7	76.5	76.6	75.1	67.9	75.2	68.8	65.1	65.6	59.9	46.1	66.0	40.0	29.2	165.923
14158.5	72.8	75.0	77.1	77.1	75.7	68.1	76.0	69.3	65.5	66.2	59.9	46.3	66.3	40.2	29.2	169.241
14218.5	73.2	75.8	77.7	77.9	76.5	68.7	76.1	69.7	65.6	65.8	60.3	46.1	66.7	40.0	29.2	172.566
14278.5	74.1	76.4	78.1	78.3	77.0	69.0	76.7	70.0	66.5	66.5	60.6	46.9	67.5	40.2	29.2	175.874
14338.6	74.6	76.8	78.5	78.7	77.6	69.4	77.2	70.6	66.8	66.5	60.8	47.0	67.4	40.4	29.2	179.135
14398.6	74.8	77.3	78.9	79.2	77.5	69.4	77.5	70.3	66.4	67.1	61.1	47.1	68.1	40.7	29.1	182.435
14458.6	74.9	77.6	79.5	79.4	77.9	69.9	77.8	70.3	66.8	67.5	61.0	46.5	68.2	40.6	29.1	185.736
14518.7	75.7	78.1	79.8	79.8	78.3	70.3	77.8	70.9	67.1	67.3	61.6	47.4	68.8	40.9	29.2	2.321
14578.7	76.1	78.3	80.2	80.3	78.6	70.3	78.2	71.0	68.0	67.5	61.3	46.8	68.3	40.5	29.2	5.556
14638.7	76.2	78.5	80.4	80.5	79.1	70.8	78.4	71.4	67.5	67.9	61.9	47.5	68.6	40.3	29.1	8.822
14698.8	76.7	78.9	80.7	81.0	79.1	70.9	78.7	71.8	67.8	67.9	61.8	48.0	69.2	40.8	29.1	12.054
14758.8	76.9	79.3	81.4	81.4	79.7	70.6	79.5	74.7	67.4	68.7	62.4	47.8	68.7	40.8	29.1	15.365
14818.8	77.5	79.6	81.6	81.6	80.0	70.6	79.3	74.5	67.6	68.4	62.5	48.3	68.7	40.7	29.3	18.679
14878.9	77.9	80.0	82.2	82.0	80.6	71.2	79.7	74.9	67.8	68.8	62.6	48.3	69.0	41.4	29.2	21.998
14938.9	78.1	80.3	82.3	82.4	80.5	70.8	80.3	75.0	68.0	68.9	63.0	48.7	69.4	41.3	29.2	25.275
14998.9	78.2	80.5	82.5	82.5	81.0	71.5	80.1	74.9	68.4	68.9	63.2	48.3	69.9	41.3	29.2	28.578
15059.0	78.3	80.4	82.2	82.0	80.5	71.6	79.0	74.7	68.3	68.7	63.2	48.3	69.5	41.4	29.1	31.876
15119.0	78.4	80.5	82.5	82.4	80.6	71.7	80.0	75.2	68.4	68.9	63.1	48.5	69.4	41.5	29.2	35.127
15179.0	78.6	80.8	82.8	82.8	81.6	71.5	80.3	75.0	68.6	69.1	63.4	48.0	69.2	41.5	29.4	38.403
15239.1	78.5	80.9	82.8	83.0	81.1	71.5	80.5	75.4	68.8	69.1	63.0	48.5	69.4	41.5	29.3	41.661
15299.1	78.9	81.1	83.2	83.0	81.5	72.1	80.8	75.5	68.6	69.3	63.3	48.9	70.1	41.4	29.2	44.884
15359.1	78.4	81.3	83.4	83.4	81.8	71.9	80.7	75.2	68.7	69.5	63.4	49.1	70.0	41.5	29.2	48.156
15419.2	79.2	81.6	83.3	83.2	81.6	71.9	81.3	75.8	68.6	69.6	63.7	49.2	69.6	42.2	29.3	51.427
15479.2	79.1	81.6	83.6	83.6	81.6	71.9	81.0	75.5	69.2	69.6	63.4	49.2	70.1	41.6	29.4	54.659
15539.2	79.1	81.9	83.9	84.0	81.9	72.1	80.9	75.7	69.2	69.6	63.5	48.8	70.4	41.8	29.5	57.839
15599.3	79.7	81.8	83.6	83.8	82.2	72.3	81.1	75.6	69.0	69.8	63.7	49.2	70.6	41.5	29.5	61.051
15659.3	79.6	81.9	83.7	83.8	82.1	72.3	81.4	75.8	69.0	69.8	63.7	48.7	70.3	41.8	29.3	64.276
15719.3	79.8	82.2	84.0	84.1	82.7	72.5	81.8	76.0	69.5	70.0	64.1	49.4	70.3	41.7	29.4	67.450
15779.4	79.5	82.0	83.9	84.2	82.3	72.6	81.3	76.2	69.7	70.2	64.1	49.0	70.3	41.9	29.5	70.685
15839.4	80.2	82.4	84.2	84.6	82.4	71.9	81.9	79.6	68.7	70.2	64.5	49.9	69.7	41.8	29.3	73.878
15899.4	80.1	82.3	84.3	84.4	83.1	71.6	81.5	79.7	68.4	70.0	64.1	49.6	70.1	42.2	29.5	77.017
15959.5	79.7	82.3	84.4	84.7	82.9	71.7	82.0	79.5	68.2	70.2	64.2	49.4	69.9	42.1	29.7	80.215
16019.5	80.0	82.4	84.6	84.6	82.6	71.6	82.1	79.8	68.8	70.4	64.3	49.3	69.4	41.9	29.6	83.391

16079.5	80.0	82.4	84.3	84.6	83.2	71.7	81.5	79.9	68.8	70.0	63.9	49.0	69.7	42.2	29.4	86.560
16139.6	80.6	82.6	84.4	84.5	83.0	71.9	82.5	79.7	68.6	70.4	64.1	49.9	70.4	42.1	29.5	89.624
16199.6	81.0	83.1	84.7	84.8	83.3	72.2	82.3	79.9	68.7	70.6	64.5	49.5	70.4	42.0	29.6	92.751
16259.6	80.5	82.9	84.8	84.7	83.3	72.2	82.2	80.0	69.2	71.0	64.2	49.7	70.0	42.1	29.7	95.882
16319.7	80.6	82.7	84.6	85.0	83.6	71.9	82.0	79.7	69.1	70.4	64.4	49.6	69.9	41.8	29.5	98.984
16379.7	80.4	82.9	84.9	85.1	83.2	72.4	82.5	80.1	69.3	70.9	64.6	48.8	70.0	42.0	29.6	102.132
16439.7	80.5	83.1	84.8	84.8	83.0	72.2	82.6	79.9	69.0	70.6	64.4	49.9	70.3	42.4	29.6	105.310
16499.8	81.0	83.1	85.1	85.1	83.3	71.8	82.4	80.1	68.8	70.6	64.5	49.8	70.3	42.2	29.7	108.482
16559.8	80.6	83.1	84.9	85.3	83.5	72.6	82.7	80.2	69.3	70.6	64.3	49.7	70.2	42.3	29.7	111.723
16619.9	80.7	82.9	84.9	84.9	83.3	72.1	82.5	79.8	68.7	70.6	64.5	49.4	70.3	42.4	29.8	114.966
16679.9	80.4	82.7	84.2	83.9	82.3	71.7	82.0	79.3	68.7	70.3	63.9	49.1	69.7	42.6	29.7	118.214
16739.9	79.5	81.7	83.3	83.1	81.7	71.2	81.2	78.2	67.9	69.4	63.4	49.7	69.4	42.5	29.6	121.402
16799.9	79.2	81.1	82.6	82.5	80.8	71.1	79.9	76.0	68.6	68.9	63.2	49.5	69.3	42.2	29.9	124.649
16860.0	78.4	80.4	81.9	81.7	79.8	70.4	79.3	74.5	67.5	68.5	62.8	49.5	68.7	42.7	29.8	127.900
16920.0	77.1	79.3	81.2	81.0	79.3	70.4	78.2	73.7	67.6	68.1	62.6	49.5	68.6	42.4	30.0	131.096
16943.4	77.4	79.1	80.7	80.7	79.2	69.8	78.1	73.3	67.2	67.9	62.3	49.3	68.2	42.6	29.9	132.350
17003.4	76.9	78.7	79.9	80.1	78.8	69.7	77.5	73.0	66.6	67.4	61.8	48.0	68.1	41.8	29.7	135.586
17063.4	76.1	77.9	79.5	79.2	77.5	68.9	77.1	72.7	66.4	67.0	61.4	47.8	67.3	41.9	29.9	138.833
17123.5	75.4	77.3	78.7	78.7	76.7	68.5	76.4	72.1	65.3	66.4	61.1	48.0	67.2	41.8	29.7	142.008
17183.5	74.1	76.5	78.3	78.0	76.3	68.1	76.0	71.7	65.3	66.1	60.9	48.5	66.4	41.9	29.9	145.228
17206.4	74.6	76.3	77.7	77.9	76.2	68.1	75.7	71.4	65.2	65.8	60.8	47.5	66.1	41.5	29.8	146.488
17266.4	73.5	75.7	77.1	77.2	75.9	67.9	75.4	71.2	64.7	65.6	60.4	47.5	66.0	41.2	29.7	149.651
17289.7	72.6	75.4	77.2	76.9	75.5	67.4	75.1	71.0	64.2	65.2	60.3	47.8	65.4	41.1	29.7	150.908
17349.8	72.9	74.9	76.5	76.5	74.8	66.9	74.5	71.0	64.3	64.9	60.1	47.5	65.2	41.3	29.9	154.126
17409.8	72.6	74.5	76.0	76.2	74.6	66.7	74.3	70.7	63.8	64.6	59.9	47.1	65.0	41.1	29.9	157.277
17469.8	72.0	74.1	75.2	75.4	[illegible]	[illegible]	74.0	70.0	63.5	64.4	59.7	46.9	64.7	40.8	30.1	160.251
17529.9	71.2	73.5	74.9	74.9	73.5	66.1	73.2	69.8	62.9	64.4	59.4	47.0	64.4	40.9	30.0	163.328
17589.9	71.5	73.1	74.2	74.6	73.2	66.0	73.4	68.7	63.5	63.8	59.0	46.7	64.3	41.1	29.9	166.459
17649.9	71.1	73.3	74.4	74.6	73.2	65.9	73.0	68.4	63.3	63.9	59.0	46.8	64.3	40.9	29.8	169.564
17710.0	70.7	72.4	74.0	74.3	73.1	66.0	72.5	68.0	63.2	63.5	58.8	46.5	63.7	40.5	30.0	172.741
17770.0	70.3	72.2	73.6	73.8	72.3	65.6	72.1	68.1	63.0	63.2	58.7	46.5	63.4	40.7	29.8	175.941
17830.0	70.3	71.9	73.5	73.8	72.4	65.5	72.1	67.6	62.7	63.5	58.6	46.7	63.5	40.5	29.9	179.087
17890.0	70.0	71.7	73.1	73.3	72.1	65.6	72.0	67.6	62.6	62.8	58.5	46.6	63.3	40.4	29.9	182.298
17950.1	69.6	71.5	73.3	73.2	72.0	65.3	71.9	67.6	62.4	63.0	58.2	46.3	63.1	40.4	30.0	185.505
18010.1	69.4	71.3	72.8	73.0	71.8	64.8	71.5	67.2	62.3	62.7	58.0	46.5	63.4	40.0	30.0	188.722
18070.1	69.2	71.1	72.7	72.7	71.5	64.8	71.6	67.1	61.7	62.7	57.8	45.9	63.3	40.5	29.8	191.888
18130.2	69.1	70.8	72.3	72.6	71.3	64.6	71.2	67.3	62.0	62.3	57.9	45.5	62.6	40.5	29.8	195.095
18190.2	69.0	70.7	72.1	72.4	71.2	64.3	71.2	67.0	61.3	62.3	57.3	45.4	62.8	40.2	30.0	198.290
18250.3	68.7	70.6	71.9	72.1	70.9	64.1	70.8	66.5	61.8	62.1	57.3	45.4	62.3	40.1	30.0	201.423
18310.3	68.6	70.3	71.7	71.8	70.5	64.1	70.3	66.3	60.6	61.4	56.8	43.8	62.1	39.9	29.8	2.910
18370.3	68.3	70.0	71.5	71.5	70.2	63.6	70.4	65.9	61.0	61.8	57.1	45.0	61.9	39.2	29.9	6.056
18430.4	68.0	69.8	71.5	71.5	70.1	63.7	70.0	66.0	60.5	61.4	56.8	45.0	61.5	39.7	29.8	9.199
18490.4	68.0	69.4	70.9	71.3	69.9	63.2	69.8	66.0	60.5	61.4	56.6	44.5	61.4	39.1	29.9	12.379
18550.4	67.6	69.4	70.7	70.6	69.4	63.2	69.7	64.6	60.7	60.7	56.2	44.7	61.4	39.4	29.7	15.606
18610.5	66.3	67.8	68.9	68.9	67.8	61.5	67.5	63.2	59.0	59.0	55.3	44.8	59.9	39.3	29.7	18.708
18633.8	65.6	66.9	67.8	67.8	66.7	60.8	66.8	61.9	58.4	58.0	54.5	43.7	59.1	39.3	29.6	19.904
18693.8	63.5	64.9	65.8	65.4	63.9	59.2	64.0	59.2	56.5	55.9	53.1	44.0	57.3	39.0	29.9	23.163
18716.7	63.0	64.1	64.9	65.0	63.7	58.3	63.0	58.9	56.1	55.4	52.7	42.9	56.6	39.3	29.9	24.487
18776.7	61.3	62.0	62.7	62.3	60.9	56.6	60.2	57.6	54.2	53.9	51.4	42.6	55.1	39.0	29.7	27.967
18800.1	60.6	61.2	61.8	61.7	60.2	55.9	59.7	58.0	53.7	53.6	51.2	42.5	54.1	39.0	29.7	29.365

18860.1	58.8	59.3	59.9	59.7	58.4	54.4	57.5	55.2	52.3	52.0	49.9	42.1	52.9	38.3	29.8	33.031
18883.2	58.0	58.6	59.2	58.9	57.5	53.9	56.7	54.5	51.8	51.5	49.5	42.1	52.3	38.5	29.7	34.417
18943.1	56.4	56.7	57.3	57.2	55.8	53.0	53.3	53.4	50.8	50.5	48.5	41.5	51.4	38.0	29.7	38.174
18966.0	55.2	56.0	56.5	56.3	54.9	52.4	52.8	53.3	50.2	49.8	47.9	41.0	50.7	37.8	29.7	39.648
18989.3	55.0	55.5	56.0	55.8	54.5	51.7	52.2	53.3	49.9	49.6	47.9	40.6	50.4	38.3	29.7	41.082
19049.4	53.6	54.0	54.2	54.2	53.1	50.5	50.8	51.9	48.3	48.1	46.8	40.2	48.9	37.2	29.5	44.916
19072.3	52.6	53.1	53.8	53.7	52.4	49.8	50.1	51.7	47.9	47.7	46.6	39.5	48.4	37.5	29.6	46.406
19132.3	51.0	51.6	52.3	52.1	50.7	48.7	49.0	50.1	46.8	46.6	45.4	38.8	47.2	36.9	29.5	50.170
19155.6	50.7	51.0	51.5	51.4	50.3	48.2	48.4	49.7	46.2	46.2	45.1	39.0	46.9	36.9	29.7	51.654
19215.6	49.3	49.7	50.3	50.0	48.9	47.2	47.1	48.4	45.6	45.4	44.1	38.0	45.6	36.6	29.6	55.481
19238.7	48.6	49.3	49.5	49.5	48.4	46.6	46.7	47.9	45.0	44.7	43.7	38.1	45.2	36.1	29.6	56.905
19298.7	47.6	48.0	48.3	48.3	47.1	45.7	45.7	46.8	44.0	43.8	42.9	37.4	44.4	35.8	29.4	60.731
19321.6	47.1	47.4	47.8	47.9	46.7	45.3	45.3	46.1	43.8	43.4	42.7	37.5	44.0	35.7	29.5	62.205
19381.6	45.9	46.2	46.6	46.6	45.6	44.5	44.3	44.8	42.7	42.6	42.0	36.8	43.1	35.3	29.3	65.971
19405.0	45.5	45.8	46.1	46.2	45.1	44.0	44.1	44.6	42.4	42.4	41.5	36.7	42.7	35.0	29.5	67.469
19464.9	44.4	44.7	45.3	45.0	44.1	43.0	43.0	43.9	41.4	41.4	40.8	36.4	41.6	34.9	29.4	71.306

Grooved Plate Dryout Experiment Data Sheet Date: 1 Oct 92 Time: 1613 Run Designation: G1E1				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			Groove blocked off	
	1.141	13.33	Power already on from run T9 T_{13} may be a bit high	
C9.4			M_{dot} 0.027 or so Groove is still fully wet	
C10.4			$\Delta t = W - C = 10.8 - 10.4 = 0.4$	
C11.4	1.453	16.94	upped power. unplugged groove	
C16.4	1.452	17.00	power check	
C22.4	1.717	20.08	upped power. Groove still fully wet. T_{13} definitely wrong	
C38.4	2.131	24.95	Meniscus still almost to top of groove	
C52.4	2.128	24.92	T_1=48 C swabbed groove. no dryout. T_4 looks WRONG so does T_8 and T_{13}	
C71.4	2.304	27.00	upped power. Groove still not dryouted	
C80.4			Dryout hard to find. Fluid in corners up to 3cm. Fluid across channel T_1=55 C	7cm
C81.4	2.210	25.90	Power down. Trying to rewet	
C90.4	2.206	25.87	Groove is rewet	
C98.4			Swabbed out front of groove. Liquid clearly flows ahead in small angle section of groove	5 cm / 2 cm
C105.4	0	0	power down steady state T_1=56°	

RUN LETTER DESIGNATION: GIEI
DATE: 10-01-1992 TIME: 16:19:03
GROOVE NUMBER: 1
THE RELATIVE HUMIDITY IS 229.124 MM OF MERCURY
THE FLOWMETER SETTING IS : 15
THE PLATE ANGLE IS 0

TIME IS SEC; SCALE IN GRAMS; T15 = 22 C

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	SCALE
60.4	32.6	32.5	32.4	32.2	32.2	32.7	32.2	31.4	31.3	31.0	29.0	28.2	26.8	26.8	21.9	15.602
83.4	32.7	32.5	32.3	32.3	32.2	32.8	32.3	31.4	31.5	31.0	29.0	28.3	26.8	26.9	21.9	16.431
143.5	32.6	32.5	32.3	32.2	32.4	32.7	32.4	31.4	31.6	30.3	28.9	28.3	26.8	27.0	22.0	18.501
203.5	32.7	32.6	32.4	32.2	32.2	32.5	32.3	31.0	31.6	30.1	28.9	28.2	26.7	26.8	22.0	20.385
263.5	32.7	32.5	32.4	32.5	32.3	32.6	32.4	31.3	31.5	30.3	29.0	28.4	26.7	26.9	22.0	22.215
323.6	32.7	32.5	32.4	32.4	32.2	32.6	32.4	31.3	31.4	30.2	28.9	28.3	26.8	26.9	22.0	23.982
383.6	32.5	32.5	32.3	32.2	32.2	32.7	32.3	31.3	31.7	30.3	29.1	28.4	26.8	27.1	22.1	25.700
443.6	32.6	32.6	32.3	32.5	32.2	32.7	32.3	31.1	31.5	30.4	28.9	28.3	26.7	26.9	22.0	27.422
503.7	32.3	32.6	32.5	32.3	32.5	32.8	32.4	31.4	31.7	30.5	29.2	28.6	26.8	27.1	22.1	29.091
563.7	32.9	32.7	32.7	32.3	32.4	32.6	32.5	31.5	31.7	30.6	28.9	28.5	26.9	27.0	22.3	30.742
623.7	32.8	32.6	32.4	32.3	32.3	32.6	32.4	31.4	31.9	30.6	29.0	28.4	26.9	27.0	22.2	32.433
683.8	32.8	32.7	32.5	32.5	32.3	32.6	32.4	31.4	31.6	30.9	29.2	28.4	26.9	27.0	22.2	34.075
743.8	32.9	32.7	32.6	32.5	32.3	32.7	32.5	31.6	31.8	30.9	29.3	28.3	26.7	27.1	22.3	35.716
803.8	33.0	32.8	32.8	32.8	32.6	32.8	32.8	31.7	31.7	31.4	29.4	28.7	25.6	27.3	22.2	37.342
863.9	33.1	33.1	33.1	33.1	32.5	33.4	33.1	32.1	32.1	31.8	29.5	28.5	26.0	27.5	22.3	38.939
923.9	33.4	33.3	33.2	33.3	32.8	33.6	33.3	32.3	32.2	32.0	29.7	29.0	25.8	27.6	22.3	40.564
983.9	33.7	33.7	33.6	33.5	32.9	34.0	33.7	32.6	32.2	32.2	30.1	29.2	26.0	27.7	22.2	42.188
1044.0	33.9	33.9	33.8	33.8	33.0	34.1	33.9	32.7	32.3	32.3	29.9	29.2	25.7	27.8	22.3	43.803
1104.0	34.1	34.0	34.1	33.9	33.1	34.4	34.2	33.1	32.7	32.6	30.1	29.3	25.6	28.0	22.4	45.381
1164.0	34.5	34.4	34.3	34.3	33.4	34.8	34.6	33.3	32.7	32.8	30.3	29.6	26.3	28.4	22.3	46.960
1224.1	34.7	34.6	34.5	34.5	33.5	34.6	33.8	33.4	32.6	32.8	30.3	29.6	26.3	28.3	22.4	48.582
1284.1	34.9	34.7	34.6	34.6	33.5	35.1	34.9	33.5	33.0	33.2	30.4	29.9	26.0	28.0	22.5	50.092
1344.1	35.0	35.0	34.8	34.8	33.8	35.3	35.2	33.7	33.0	33.3	30.5	29.8	26.6	28.6	22.3	51.608
1404.2	35.4	35.3	35.2	35.1	33.9	35.6	35.3	34.1	33.2	33.4	30.7	30.1	26.5	28.6	22.6	53.084
1464.2	35.6	35.6	35.4	35.5	34.4	36.0	35.8	34.6	33.4	33.9	31.2	30.7	26.5	28.9	22.3	54.561
1524.2	35.8	35.9	35.9	35.8	34.6	36.4	36.3	35.0	33.6	34.3	31.0	30.6	26.9	29.2	22.3	56.050
1584.3	36.3	36.2	36.3	36.2	34.9	37.0	36.7	35.5	34.1	34.7	31.6	30.9	26.9	29.4	22.5	57.497
1644.3	36.9	36.9	36.8	36.9	35.1	37.5	37.3	35.6	34.5	35.0	31.8	31.2	27.1	29.8	22.4	58.929
1704.3	37.4	37.3	37.1	37.2	35.4	37.9	37.8	36.1	34.5	35.5	32.2	31.8	27.2	30.1	22.6	60.379
1764.4	37.6	37.8	37.6	37.5	35.6	38.3	38.0	36.2	34.7	35.5	32.1	32.0	27.4	30.2	22.5	61.811
1824.4	38.1	38.0	38.2	38.0	35.8	38.7	38.4	36.8	35.3	36.0	32.7	32.2	27.5	30.6	22.6	63.292
1884.4	38.3	38.4	38.4	38.1	36.1	38.9	38.6	36.9	35.4	36.1	32.6	32.2	27.5	30.6	22.5	64.739
1944.5	38.7	38.0	38.7	38.5	36.4	39.2	38.9	37.2	35.6	36.3	32.8	32.6	27.4	31.1	22.7	66.226
2004.5	39.2	39.0	39.1	38.9	36.5	39.6	39.2	37.3	35.7	36.6	33.1	32.7	27.7	31.0	22.6	67.706
2064.5	39.3	39.4	39.3	39.2	36.6	39.7	39.5	37.7	35.8	36.9	33.2	33.0	28.0	31.4	22.6	69.162
2124.6	39.6	39.7	39.3	39.7	36.9	40.0	39.9	38.0	36.0	37.1	33.4	33.1	28.1	31.6	22.6	70.642
2184.6	39.7	39.7	39.6	39.7	37.0	40.5	40.0	38.3	36.3	37.2	33.7	33.6	28.3	32.0	22.6	72.132
2244.6	40.2	40.0	40.1	39.9	37.5	40.6	40.5	38.2	36.6	37.2	33.6	33.6	28.4	32.0	22.7	73.623
2304.7	40.3	40.3	40.0	40.1	37.4	40.9	40.5	38.5	36.6	37.5	33.6	33.8	27.9	32.1	22.8	75.085
2364.7	40.8	40.7	40.6	40.5	37.8	41.3	40.9	38.9	36.8	38.2	34.3	34.3	28.4	32.4	22.9	76.596
2424.7	41.2	41.2	41.0	40.9	38.3	41.8	41.6	40.0	37.1	38.8	34.6	34.4	28.4	33.0	22.8	78.087
2484.8	41.7	41.9	41.5	41.7	38.7	42.5	42.6	40.4	37.8	39.5	35.2	35.2	28.8	33.6	22.7	79.559

2544.8	42.0	42.3	42.1	42.1	39.4	43.1	43.0	40.7	37.8	39.9	35.4	35.2	28.3	33.8	22.7	81.047
2604.9	42.9	43.0	42.8	42.9	39.2	44.0	43.7	41.6	38.6	40.6	35.6	35.8	29.2	34.4	22.8	82.527
2664.9	43.5	43.8	43.6	43.8	40.0	44.7	44.4	42.4	39.2	41.0	36.2	36.3	29.1	34.9	22.9	83.991
2724.9	43.9	44.5	44.2	44.6	40.5	45.4	45.2	42.8	39.4	41.4	36.5	37.0	29.9	35.3	22.9	85.462
2784.9	44.5	44.9	44.7	45.0	40.8	45.8	45.7	43.0	[illegible]	42.1	37.0	37.0	30.1	35.8	22.7	86.963
2845.0	45.2	45.5	45.2	45.6	41.1	46.4	46.3	43.8	40.4	42.4	37.1	37.6	29.9	36.1	22.8	88.476
2905.0	45.8	46.0	45.9	46.0	41.9	46.9	46.8	44.0	40.5	42.9	37.6	38.3	30.4	36.3	23.1	89.945
2965.1	46.4	46.7	46.3	46.6	41.9	47.6	47.4	44.6	41.1	43.3	38.1	38.4	30.8	36.8	22.9	91.484
3025.1	46.9	47.0	46.8	46.8	42.3	47.9	47.5	45.0	41.3	43.5	38.1	38.7	30.6	37.2	23.0	93.010
3085.1	47.3	47.4	47.3	47.4	42.5	48.4	48.2	45.5	41.7	43.9	38.7	39.1	31.0	37.6	23.2	94.492
3145.1	47.6	47.9	47.8	48.1	43.3	48.8	48.5	45.6	41.9	44.2	38.8	39.4	31.1	37.7	23.1	95.988
3205.2	47.9	48.2	48.0	48.2	43.5	49.1	48.8	46.3	42.0	44.3	39.0	39.6	31.5	38.1	23.2	97.427
3265.2	48.2	48.5	48.3	48.4	43.6	49.5	49.3	46.1	42.3	44.8	39.2	40.3	31.5	38.3	23.2	98.820
3325.3	48.7	48.8	48.6	48.9	43.8	49.8	49.4	46.5	42.7	45.1	39.4	40.2	31.9	38.6	23.2	100.230
3385.3	49.0	49.1	49.1	49.2	43.8	50.1	49.9	47.0	43.2	45.3	39.6	40.6	31.6	38.9	23.3	101.658
3445.3	49.3	49.6	49.4	49.4	44.4	50.2	49.9	46.8	42.8	45.3	39.8	40.5	32.2	39.3	23.1	103.095
3505.4	49.5	49.9	49.3	49.9	44.3	50.8	50.4	47.1	43.6	45.7	40.0	41.1	32.3	39.4	23.4	104.514
3565.4	49.8	50.1	49.8	50.1	45.0	51.0	50.7	47.3	43.5	46.1	40.3	41.0	32.2	39.5	23.2	105.926
3625.4	50.1	50.4	50.0	50.3	45.3	51.0	50.9	47.4	44.4	46.3	40.6	40.1	32.3	40.2	23.3	107.410
3685.4	50.1	50.5	50.0	49.7	46.8	51.3	51.0	47.9	44.6	46.2	40.4	38.8	32.7	40.5	23.5	108.837
3745.5	50.2	50.5	50.3	50.6	47.0	51.4	51.1	48.1	45.2	46.3	40.7	36.9	32.3	40.8	23.4	110.244
3805.5	50.7	50.7	50.2	50.8	49.8	51.6	51.4	48.2	44.4	46.7	40.8	37.1	32.9	40.3	23.4	111.721
3865.6	50.5	51.0	50.5	51.0	47.3	51.8	51.6	48.2	45.7	46.9	40.9	37.3	32.8	41.5	23.7	113.152
3925.6	50.9	51.0	50.7	51.3	48.7	52.0	51.6	48.6	45.0	46.9	41.0	37.5	33.2	41.0	23.5	114.561
3985.6	50.9	51.4	51.1	51.5	49.5	52.2	51.9	48.5	44.8	47.0	41.0	37.3	33.3	40.9	23.5	116.045
4045.6	51.1	51.7	51.1	51.6	54.1	52.3	51.9	48.7	42.5	47.1	41.1	37.6	33.1	38.8	23.5	117.491
4105.7	51.4	51.4	51.4	51.7	54.4	52.2	52.1	49.1	42.4	47.1	41.5	37.8	33.4	38.6	23.6	118.883
4165.7	51.4	51.7	51.4	51.5	54.6	52.4	52.2	48.8	42.9	47.1	41.4	37.8	33.7	39.0	23.7	120.291
4225.8	51.5	51.7	51.4	51.8	54.8	52.5	52.1	48.8	43.0	47.5	41.4	37.9	33.2	38.6	23.8	121.692
4285.8	51.8	52.0	51.6	51.8	54.8	52.7	52.4	49.3	43.1	47.2	41.4	37.8	33.0	38.4	23.6	123.075
4345.8	51.8	52.4	51.8	52.4	54.9	52.8	52.6	49.1	43.0	47.7	41.9	38.1	33.5	39.1	23.7	124.476
4405.9	52.0	52.4	52.0	52.3	55.3	53.2	52.9	49.7	43.0	48.2	42.2	38.1	33.7	39.5	23.8	125.874
4465.9	52.3	52.5	52.3	52.9	55.6	53.6	53.3	49.8	43.8	48.6	42.2	38.4	34.0	39.7	24.0	127.218
4525.9	52.6	52.9	52.6	53.0	55.9	53.9	53.7	50.3	43.0	48.6	42.2	38.6	33.4	39.7	24.1	128.632
4585.9	53.1	53.1	53.0	53.5	56.4	54.3	54.0	50.6	44.2	49.1	43.0	38.7	34.0	40.0	24.0	130.021
4646.0	53.3	53.8	53.3	53.8	56.7	54.7	54.4	50.9	44.3	49.3	43.1	39.0	34.1	40.6	23.9	131.408
4706.0	53.5	54.0	53.6	54.2	57.2	55.0	54.8	51.2	44.9	49.6	43.2	39.2	34.4	40.4	24.2	132.802
4766.1	53.6	54.1	53.3	53.7	57.2	54.7	54.8	51.0	44.3	49.6	43.4	39.4	34.5	40.3	24.3	134.194
4826.1	54.1	54.1	54.0	54.5	57.7	55.4	55.4	51.6	45.0	49.9	43.6	39.5	34.6	40.3	23.9	135.601
4886.1	54.2	54.6	54.1	54.6	53.1	55.4	55.1	51.5	47.2	50.0	43.5	39.8	34.6	42.8	24.3	136.981
4946.1	54.6	55.0	54.4	54.8	51.9	56.0	55.6	51.8	48.5	50.4	43.8	39.9	34.8	44.2	24.1	138.390
5006.2	54.8	55.2	54.9	55.1	54.1	56.1	55.9	52.2	48.1	50.5	43.8	40.0	35.0	42.9	24.4	139.809
5066.2	54.9	55.3	55.0	55.3	52.6	56.3	56.0	52.0	48.9	50.4	43.7	40.2	35.5	44.0	24.2	141.202
5126.3	55.2	55.6	55.1	55.4	54.1	56.3	56.0	51.6	47.9	50.4	43.7	40.0	35.0	43.3	24.4	142.568
5186.3	55.2	55.7	55.1	55.5	53.0	56.4	56.0	52.1	48.4	50.4	44.0	40.3	35.6	44.6	24.2	143.917
5246.3	55.2	55.7	55.1	55.3	52.6	56.3	56.3	52.5	48.7	50.7	43.9	40.4	35.4	44.8	24.4	145.261
5306.4	55.0	55.7	55.2	55.7	52.7	56.4	56.2	52.4	48.7	50.9	44.1	40.4	35.2	44.3	24.4	146.590
5366.4	55.1	55.7	55.1	55.5	52.6	56.3	56.1	52.3	48.9	50.5	43.9	40.3	35.5	44.9	24.6	147.925
5426.4	55.2	55.7	55.3	55.8	54.5	56.3	56.2	52.8	48.3	50.8	44.5	40.5	35.6	44.1	24.5	149.256
5486.5	55.5	55.9	55.4	55.8	54.6	56.5	56.2	52.6	48.2	51.0	44.1	40.7	35.8	43.9	24.8	150.555

5546.5	55.2	55.7	55.1	55.5	53.8	56.6	56.3	52.6	48.5	50.7	44.5	40.8	35.7	44.4	24.4151.882
5606.5	55.2	55.7	55.0	55.4	54.4	56.2	56.1	51.9	47.6	50.6	43.8	40.6	35.7	43.9	24.7153.192
5666.6	55.4	55.8	55.2	55.8	54.7	56.5	56.4	52.6	48.2	51.1	44.4	40.8	35.8	44.1	24.7154.473
5726.6	55.6	56.0	55.5	55.9	54.0	56.8	56.6	52.6	49.0	51.2	44.9	40.9	36.0	44.2	24.9155.781
5786.6	55.6	55.9	55.4	55.9	54.6	56.8	56.6	52.6	48.5	51.2	44.8	41.1	36.0	44.6	24.9157.090
5846.7	55.5	55.8	55.4	55.6	54.3	56.6	56.6	52.9	48.9	51.2	44.6	41.0	36.0	44.4	24.8158.354
5906.7	55.5	55.9	55.2	55.6	59.0	56.7	56.7	52.8	46.6	51.4	44.6	41.1	36.3	41.9	25.1159.605
5966.7	55.6	56.0	55.4	56.0	59.1	56.8	56.5	52.2	46.0	51.2	44.8	41.2	36.1	41.9	25.1160.917
6026.8	55.5	56.2	55.5	55.9	59.2	56.9	56.4	52.5	46.1	51.0	44.4	41.0	35.3	41.7	24.8162.174
6086.8	55.5	55.9	55.4	55.9	59.1	56.7	56.4	52.6	46.3	51.2	44.5	40.9	35.9	41.6	25.1163.399
6146.8	55.7	56.1	55.7	56.1	59.2	56.8	56.6	52.7	46.0	51.5	44.9	41.1	36.0	41.7	25.1164.670
6206.9	55.5	55.9	55.3	55.7	59.0	56.8	56.5	52.9	46.2	51.2	44.9	41.2	35.9	42.1	25.1165.926
6266.9	55.5	55.9	55.2	55.6	59.1	56.8	56.7	52.7	46.0	51.3	44.9	41.2	35.8	42.0	25.2167.141
6326.9	55.5	55.9	55.5	55.8	59.1	56.8	56.5	52.4	46.3	51.2	44.4	41.0	36.3	42.4	25.2168.366
6387.0	55.5	55.8	55.4	55.5	58.7	56.3	55.9	51.7	46.0	50.3	44.0	41.0	36.2	41.1	25.3169.598
6447.0	54.7	54.8	54.3	54.4	57.5	55.0	54.3	50.1	45.2	48.4	43.4	40.7	36.5	40.5	25.4170.814
6507.0	53.6	53.6	52.6	53.0	55.9	53.5	52.5	48.3	44.4	47.2	42.3	40.1	36.0	39.4	25.4172.016
6530.4	53.1	53.1	52.2	52.2	55.0	52.6	52.0	48.3	43.9	46.9	42.0	40.1	35.9	39.3	25.4172.486
6590.4	51.6	52.0	50.7	50.7	52.9	50.9	50.4	46.6	43.6	45.1	40.9	39.3	35.4	38.8	25.3173.691
6613.5	51.3	51.3	50.3	50.3	52.7	50.2	49.7	46.2	43.3	44.2	41.0	38.9	35.4	38.4	25.2174.165
6673.4	50.1	49.6	48.9	48.8	46.8	48.8	48.2	44.9	44.6	44.1	40.1	38.4	35.0	39.6	25.5175.358
6696.4	49.4	49.3	48.4	48.3	46.2	48.1	47.7	44.6	44.5	43.6	39.9	38.0	34.7	39.5	25.4175.816
6756.4	48.2	47.7	47.1	46.8	45.0	46.8	46.4	43.1	43.6	42.6	39.2	37.6	34.7	38.5	25.4176.985

Grooved Plate Dryout Experiment Data Sheet

Date: 2 Oct 92 Time: 1608 Run Designation: G1E3

Runtime (min)	Amps	Volts	Comments	Dryout Length
C0	2.070	24.25	Plate hot from T9 test	
C6.4			Squirted fresh ethanol in groove to clean out!	
C11.2			Dried out full front	17 cm
C13.2	1.923	22.53	Powered down	
C27.2	1.926	22.57	Groove not rewet $T_l=52$	12
C28.2	1.785	20.90	Powered down	
C36.2	1.785	20.92	Swabbed and squirted groove. Looks dirty	
C47.2			Last few minutes been cleaning groove at dam. Some blockage. Groove rewet $T_l=47$ C	
C48.2	1.882	22.02	Upped power a bit. I can see particles carried in the fluid in the groove ⇒ might be a way to measure flowrate. M_{dot} is effected because groove #2 is wet.	
C56.2	2.000	23.42	Upped power. Groove still wet fully.	
C61.2			Checked bob in flow meter. It's loose ⇒ I don't understand why flowrate is so low. Puddle extends 8 cm from dam so not near dryout.	
C66.2	2.138	25.06	Upped power to groove $T_l=49$ C	
C92.2			Meniscus depressed but groove still wet $T_l=54$ C	
C93.2	2.221	26.05	Upped power	
C103.2			Squirted groove to clean out end $T_l=56$	

Grooved Plate Dryout Experiment Data Sheet

Date: 2 Oct 92 Time: 1608 Run Designation: GIE3

Runtime (min)	Amps	Volts	Comments	Dryout Length
C109.4	2.221	26.06	There's a dimple for a full front at 17 cm ⇒ but whole groove remains moist ⇒ although no visible meniscus. This point probably exceeds $Q_{c,max}$. T_l=56 There's sill a 6 cm puddle at dam.	
C113.4	2.221	26.06	Emptied flask Full front	17cm
C120.4			Full front	19
C121.4	2.221	26.05	Full front Shut down M_{dot} ~ 0.0178	19

RUN LETTER DESIGNATION: GIE3
DATE: 10-02-1992 TIME: 16:13:46
GROOVE NUMBER: 1
THE RELATIVE HUMIDITY IS 28.978 MM OF MERCURY
THE FLOWMETER SETTING IS : 15
THE PLATE ANGLE IS 0

TIME IN SEC; SCALE IN GRAMS; T15 = 22 C

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	SCALE
60.5	55.2	55.3	54.7	54.6	54.7	55.6	55.5	52.6	48.7	50.7	45.0	41.4	38.4	43.6	24.0	0.708
83.6	55.2	55.2	54.6	54.4	54.9	55.6	55.5	52.3	48.1	50.8	44.8	41.4	38.4	43.8	24.1	0.708
143.6	55.0	55.5	54.4	54.4	54.6	55.5	55.5	52.6	48.3	50.7	44.6	41.2	38.4	43.1	23.9	0.729
203.6	55.2	55.5	54.6	54.3	55.0	55.4	55.5	52.8	47.9	50.7	44.3	41.1	38.3	42.8	24.0	5.568
263.6	55.0	55.3	54.3	54.4	57.8	55.4	55.6	52.3	46.2	50.5	44.5	41.1	38.1	42.1	23.9	9.930
323.7	54.9	55.2	54.3	54.1	57.7	55.3	55.4	52.7	46.9	50.7	44.4	41.1	38.1	41.5	24.0	13.260
383.7	54.9	55.0	54.4	54.3	57.7	55.1	55.3	52.3	46.4	50.5	44.5	41.1	38.1	41.5	23.9	15.984
443.8	54.3	53.4	53.3	53.7	56.4	54.6	54.4	52.1	46.8	50.3	44.6	40.6	37.8	41.5	23.9	18.334
503.8	50.6	52.2	51.1	51.8	49.9	50.9	53.0	51.9	49.6	50.2	44.0	40.0	37.8	43.7	24.0	20.414
527.1	52.0	51.1	50.2	50.5	49.8	51.0	52.5	51.8	49.2	50.1	44.1	40.3	37.6	43.3	23.9	21.195
550.1	52.8	50.9	48.3	49.8	49.2	51.0	52.2	51.9	49.3	50.2	44.0	40.6	37.9	43.1	24.1	21.905
610.1	53.8	51.2	48.6	46.5	48.7	52.1	51.9	51.6	49.4	50.0	44.1	40.7	38.1	43.3	24.0	23.746
670.1	53.6	52.2	51.1	46.2	49.0	53.3	53.6	51.3	49.0	50.0	44.0	40.5	37.7	43.6	24.0	25.494
730.1	53.8	53.6	52.5	50.7	49.3	53.9	54.2	51.1	48.9	49.8	43.5	40.6	37.8	43.5	24.1	27.141
790.2	53.9	54.3	53.0	52.7	49.8	54.1	54.5	51.9	49.0	50.0	43.9	40.6	37.6	43.7	24.1	28.733
850.2	54.0	54.2	53.3	53.0	50.0	54.3	54.4	51.7	49.5	49.9	44.3	40.5	37.9	43.3	23.9	30.311
910.2	53.6	50.7	47.6	51.3	49.0	53.9	54.0	51.3	48.9	49.5	43.7	40.5	37.8	43.5	24.1	31.836
970.3	53.7	51.9	49.1	48.3	48.4	53.8	54.0	50.9	48.6	49.5	43.9	40.4	37.9	42.9	24.2	33.323
1030.3	53.4	53.2	51.5	45.3	48.6	53.7	53.7	50.5	48.8	49.1	43.6	40.3	37.9	42.9	24.2	34.820
1090.3	53.1	53.4	52.2	46.6	48.8	53.5	53.6	50.3	48.8	49.1	43.6	40.4	37.8	43.0	24.2	36.286
1150.4	53.2	53.4	52.4	50.0	49.0	53.5	53.4	50.4	48.6	49.1	43.3	40.1	37.8	42.9	24.2	37.779
1210.4	53.0	53.4	52.4	51.2	49.2	53.3	53.3	50.3	48.4	48.9	43.5	40.0	37.8	42.9	24.3	39.231
1270.4	53.0	53.3	52.3	51.6	49.4	53.3	53.0	50.2	48.3	48.8	43.1	40.2	37.4	42.9	24.3	40.693
1330.5	52.9	53.1	52.2	51.9	49.4	53.0	53.1	50.0	48.3	48.9	43.4	40.1	37.7	42.6	24.4	42.150
1390.5	52.7	52.9	52.3	51.8	49.6	52.8	52.8	50.3	48.3	48.6	43.2	40.0	37.5	42.6	24.2	43.561
1450.5	52.7	52.9	52.0	51.5	49.0	52.8	52.7	50.1	48.4	48.6	42.8	39.9	37.4	42.2	24.4	45.025
1510.6	52.6	52.7	51.9	51.6	48.9	52.6	52.7	49.9	48.1	48.4	43.1	40.0	37.3	42.1	24.3	46.473
1570.6	52.4	52.5	51.7	51.1	48.9	52.3	52.6	50.0	48.1	48.2	42.8	39.9	37.2	42.0	24.4	47.856
1630.6	52.4	52.5	51.4	51.1	48.6	52.2	52.7	50.0	48.0	48.4	43.1	39.8	37.4	41.9	24.4	49.287
1690.7	52.2	52.2	51.7	51.6	49.1	52.3	52.5	49.8	48.1	48.3	42.9	39.7	37.4	41.4	24.6	50.714
1750.7	52.1	52.1	51.8	51.4	48.8	52.3	52.4	49.6	47.8	47.9	42.5	39.6	37.4	41.7	24.5	52.127
1810.7	52.1	52.0	51.5	51.8	48.9	52.1	52.5	49.1	47.6	47.7	42.4	39.5	37.1	41.6	24.5	53.514
1870.8	52.0	52.0	51.5	51.1	48.4	51.8	51.9	48.9	47.6	47.4	42.2	39.3	36.8	41.7	24.3	54.900
1930.8	51.7	51.9	51.1	51.1	48.7	51.6	51.9	48.6	47.2	47.4	42.3	39.3	37.0	41.9	24.5	56.319
1990.8	51.4	51.8	50.9	50.7	48.4	51.4	51.6	48.6	47.3	47.1	42.1	39.3	36.9	41.6	24.6	57.701
2050.9	51.2	51.5	50.7	50.7	48.0	51.2	51.5	48.2	47.4	47.2	42.2	39.3	36.7	41.4	24.8	59.121
2110.9	51.0	50.8	50.3	50.3	47.9	50.9	51.0	47.9	47.0	46.9	41.8	39.0	36.9	41.6	24.5	60.528
2170.9	50.8	50.8	49.7	50.2	47.6	50.6	51.0	48.2	47.0	46.8	41.7	38.9	36.7	41.1	24.6	61.929
2231.0	50.2	47.1	47.3	48.1	47.3	50.0	50.6	47.7	46.7	46.6	41.5	38.8	36.4	40.8	24.8	63.332
2291.0	49.9	47.2	44.6	46.7	47.2	49.9	50.3	47.2	46.3	46.5	41.5	38.7	36.7	40.9	24.7	64.731
2351.0	49.7	48.6	44.8	45.1	47.2	49.7	50.1	47.4	46.1	46.4	41.6	38.5	36.4	40.6	24.7	66.137
2411.1	49.4	49.4	47.0	43.3	46.8	49.5	49.9	47.2	46.3	46.1	41.2	38.4	36.3	40.5	24.7	67.515

2471.1	49.4	49.5	48.0	43.1	46.6	49.4	49.7	47.1	46.0	46.0	40.9	38.4	36.3	40.5	24.8	68.803
2531.1	49.4	49.4	48.3	46.2	46.5	49.3	49.6	46.7	46.0	45.7	40.9	38.1	35.9	39.8	24.8	70.057
2591.2	49.1	49.2	48.0	47.7	46.6	49.1	49.5	46.9	45.8	45.7	40.8	37.9	36.0	39.8	24.8	71.241
2651.2	49.0	49.2	48.4	47.9	46.2	49.0	49.3	46.9	45.3	45.4	40.6	37.8	35.8	39.5	24.8	72.370
2711.2	48.7	47.7	48.1	48.0	46.4	49.0	49.1	46.4	45.1	45.3	40.4	37.6	35.6	39.5	24.8	73.478
2771.3	48.7	48.7	47.9	48.0	45.9	48.8	48.9	46.6	44.8	44.9	39.9	36.7	35.1	39.3	24.8	74.523
2831.3	48.5	47.2	47.9	47.8	46.0	48.5	48.9	46.1	45.2	44.9	40.1	36.5	35.4	39.4	24.9	75.547
2891.3	48.2	47.0	47.6	47.7	45.1	46.8	48.7	46.0	44.6	44.0	40.1	36.0	34.1	38.9	25.0	76.528
2951.4	48.3	48.5	47.8	47.5	45.3	48.1	48.4	45.9	44.8	44.4	39.9	35.9	33.6	39.0	24.9	77.504
3011.4	48.2	48.4	47.6	47.7	45.4	48.3	48.4	45.7	44.7	44.5	39.7	36.5	34.4	38.7	25.0	78.463
3071.4	48.2	48.2	47.6	47.6	45.3	48.2	48.4	46.0	44.6	44.4	39.8	36.7	34.6	38.4	25.0	79.424
3131.5	48.2	48.3	47.6	47.5	45.6	48.2	48.4	45.7	44.2	44.6	39.8	36.6	34.5	38.7	24.8	80.400
3191.5	48.3	48.3	47.7	47.9	45.6	48.3	48.4	45.8	44.4	44.7	39.5	36.6	34.6	38.9	25.0	81.331
3251.5	48.3	48.4	47.6	47.8	45.4	48.4	48.4	45.9	44.8	44.4	39.4	36.6	34.3	38.5	25.1	82.289
3311.6	48.2	48.5	47.7	47.6	45.4	48.4	48.7	46.1	44.4	44.6	39.5	36.4	34.5	38.7	25.1	83.237
3371.6	48.2	48.3	47.6	47.6	45.6	48.3	48.5	46.0	44.5	44.4	39.3	36.3	34.4	38.9	25.0	84.145
3431.6	48.1	48.4	47.7	47.9	45.4	48.4	48.7	46.1	44.8	44.7	39.8	36.6	34.5	38.8	25.0	85.110
3491.7	48.3	48.4	47.7	47.8	45.7	48.6	48.7	46.3	44.8	44.8	39.8	36.6	34.5	39.1	25.0	86.094
3551.7	48.3	48.5	47.7	47.9	45.9	48.4	49.0	46.1	44.3	44.7	39.7	36.6	34.8	39.0	25.1	87.081
3611.7	48.5	48.8	48.0	48.1	45.6	48.8	49.2	46.8	45.1	45.2	39.8	36.8	34.8	39.1	25.2	88.086
3671.8	48.6	48.8	48.2	48.4	45.9	49.1	49.2	46.7	45.1	45.3	40.1	36.9	34.7	39.1	25.2	89.140
3731.8	48.9	49.0	48.3	48.4	45.7	49.3	49.7	47.0	45.1	45.5	40.0	36.9	34.6	39.1	25.0	90.223
3791.8	49.0	49.3	48.3	48.6	46.1	49.5	49.8	47.0	45.5	45.7	40.2	37.0	34.7	39.5	25.0	91.315
3851.9	49.1	49.3	48.6	48.6	46.2	49.7	49.7	46.8	45.3	45.6	40.2	37.2	34.8	39.5	25.2	92.420
3911.9	49.2	49.5	49.0	48.9	46.6	49.4	50.0	47.5	45.5	45.8	40.5	37.3	34.8	39.8	25.2	93.576
3971.9	49.3	49.6	48.9	48.9	46.5	49.8	50.1	47.5	45.6	46.0	40.7	37.3	34.5	40.0	25.1	94.695
4032.0	49.5	49.8	49.2	49.1	46.7	49.8	50.3	47.8	46.1	46.2	40.5	37.3	34.8	39.7	25.0	95.866
4092.0	49.7	50.0	49.3	49.5	46.8	50.2	50.7	47.9	45.9	46.5	40.7	37.4	35.0	39.7	25.2	97.049
4152.0	49.9	50.2	49.4	49.3	46.9	50.3	50.8	47.9	46.2	46.8	41.0	37.5	34.9	40.0	25.2	98.230
4212.1	50.0	50.5	49.7	49.8	47.1	50.9	51.2	48.2	46.4	47.0	41.3	37.6	35.0	40.4	25.0	99.412
4272.1	50.4	50.4	49.9	50.3	47.2	50.3	51.4	48.7	46.9	47.3	41.3	37.6	35.3	40.4	25.1	100.614
4332.1	50.6	51.0	50.3	50.5	47.9	51.4	51.6	48.7	46.7	47.3	41.7	38.0	35.3	40.7	25.2	101.826
4392.2	51.0	51.1	50.6	50.9	47.8	51.3	51.8	48.7	46.7	47.5	41.6	38.0	35.0	40.7	25.2	103.015
4452.2	51.1	51.5	51.0	50.8	48.2	51.7	52.0	49.4	46.9	47.7	41.9	38.0	35.4	40.8	25.3	104.233
4512.2	51.6	52.0	50.9	51.4	48.5	52.1	52.5	49.4	47.0	48.0	42.2	38.2	35.5	41.1	25.2	105.450
4572.3	51.7	52.1	51.1	51.2	48.7	52.1	52.6	49.7	47.4	48.0	41.8	38.3	35.3	41.3	25.3	106.657
4632.3	51.8	52.3	51.6	51.7	48.5	52.4	52.7	49.3	47.8	48.2	42.1	38.3	35.9	41.4	25.2	107.869
4692.3	51.9	52.3	51.6	52.0	49.0	52.8	52.9	49.8	47.6	48.2	42.5	38.6	35.6	41.6	25.3	109.090
4752.4	52.3	52.6	52.2	51.9	49.2	52.9	53.1	50.1	47.7	48.2	42.5	38.6	36.1	41.6	25.3	110.323
4812.4	52.5	52.8	52.2	52.4	49.4	53.2	53.4	50.3	47.8	48.5	42.7	38.8	35.9	42.0	25.2	111.535
4872.4	52.9	53.0	52.5	52.4	49.9	53.3	53.3	50.4	47.9	48.7	42.7	39.0	35.9	42.2	25.2	112.765
4932.5	52.7	53.2	52.4	52.4	49.7	53.2	53.5	50.1	47.9	48.5	42.2	38.8	35.9	42.0	25.4	114.007
4992.5	52.9	53.0	52.2	52.3	50.0	52.8	53.7	50.3	47.9	48.7	42.4	38.9	36.0	42.2	25.2	115.210
5052.5	53.2	52.9	50.5	51.1	50.2	53.3	53.7	50.7	47.7	48.9	42.8	39.0	36.2	41.8	25.4	116.450
5112.6	52.9	50.9	50.1	50.2	49.3	53.2	53.7	50.7	45.1	47.3	41.1	38.6	34.8	41.2	25.2	117.666
5172.6	53.2	53.2	52.4	48.2	48.4	53.4	53.8	50.9	47.9	48.9	42.8	39.2	35.2	41.8	25.5	118.897
5232.6	53.3	53.6	53.1	46.8	48.4	53.6	54.0	51.1	48.3	49.3	42.8	39.3	34.9	42.2	25.3	120.116
5292.7	53.5	53.4	53.3	47.3	48.8	53.6	54.1	50.8	48.4	49.1	43.0	39.3	35.4	42.2	25.4	121.354
5352.7	53.7	53.8	53.3	50.7	49.3	53.9	54.1	50.8	48.7	49.3	43.0	39.4	35.3	42.4	25.2	122.577
5412.8	53.6	53.9	53.3	52.2	49.6	53.9	54.3	51.2	48.6	49.3	43.3	39.6	35.7	42.3	25.3	123.792

5472.8	53.9	54.1	53.5	52.9	50.2	54.1	54.4	51.1	48.8	49.4	43.1	39.5	35.5	42.4	25.3	125.034
5532.8	53.5	53.8	53.3	53.0	50.3	54.2	54.5	51.4	49.0	49.3	43.2	39.3	35.2	42.6	25.3	126.250
5592.8	53.8	54.0	53.2	52.8	50.5	54.2	54.6	50.9	48.4	49.2	43.2	39.6	34.8	42.6	25.3	127.418
5652.9	54.1	54.2	53.8	53.3	50.7	54.4	54.5	51.6	48.7	49.6	43.1	39.5	35.9	43.0	25.3	128.619
5712.9	54.2	54.4	53.9	53.6	51.2	54.7	55.0	51.7	49.0	50.0	43.6	39.7	35.7	42.4	25.4	129.835
5772.9	54.3	54.7	54.2	53.9	51.5	54.9	55.1	51.7	49.0	49.8	43.4	39.7	35.2	42.6	25.4	130.989
5833.0	54.6	54.6	54.0	53.7	51.3	54.7	55.3	52.1	49.2	49.9	43.3	39.8	35.6	42.8	25.3	132.180
5893.0	54.7	55.1	54.3	54.0	51.8	55.1	55.6	51.9	49.1	50.1	43.7	39.8	35.6	42.7	25.3	133.388
5953.1	54.8	55.3	54.3	54.4	52.8	55.6	55.7	52.6	49.6	50.3	44.1	40.1	35.7	42.1	25.4	134.563
6013.1	54.8	55.4	54.5	54.5	53.0	55.7	55.9	52.2	49.4	50.5	44.4	40.2	35.6	42.2	25.4	135.761
6073.1	55.3	55.6	54.8	54.9	52.8	55.7	56.2	52.5	49.4	50.8	44.6	40.4	36.2	42.8	25.4	136.969
6133.1	55.3	55.6	55.0	55.1	53.5	54.8	56.4	52.9	49.8	50.9	44.7	40.4	35.9	42.2	25.6	138.158
6193.2	51.3	52.0	51.5	50.3	52.7	51.8	55.9	52.9	51.5	50.8	44.4	40.4	35.6	39.1	25.3	139.342
6216.5	51.2	52.3	53.3	48.4	53.2	52.3	56.1	52.4	51.9	51.0	44.6	40.5	35.6	39.4	25.6	139.808
6276.6	53.3	54.6	54.5	48.3	53.6	54.3	56.2	52.8	52.0	50.9	44.6	40.5	36.1	39.0	25.3	140.984
6299.5	53.9	55.0	54.7	49.6	54.2	54.9	56.2	52.9	51.6	51.1	44.7	40.7	35.9	39.3	25.7	141.445
6359.5	55.0	55.5	54.9	53.8	54.4	55.6	56.3	52.9	51.9	51.2	44.7	40.7	35.9	39.5	25.5	142.545
6382.4	55.1	55.3	54.7	53.8	53.7	55.7	56.4	52.9	52.2	50.9	44.6	40.7	37.1	39.2	25.5	142.923
6442.4	55.2	55.6	54.8	54.4	54.8	55.9	56.6	53.0	51.1	51.1	44.6	40.7	37.4	38.6	25.6	143.903
6502.5	55.[illegible]	55.7	55.0	54.8	54.6	56.1	56.5	52.9	51.9	51.3	45.0	40.9	36.8	38.9	25.6	144.947
6562.5	55.5	56.0	54.9	54.7	55.1	56.1	56.4	53.5	52.0	51.2	44.9	40.8	37.0	38.8	25.5	146.003
6622.5	55.5	55.9	55.0	54.7	54.9	56.3	56.7	53.1	52.1	51.2	44.8	40.9	37.1	38.5	25.6	147.066
6682.6	55.7	56.2	55.2	55.3	55.6	56.5	56.7	53.0	52.4	51.3	45.2	40.9	37.0	38.2	25.6	148.182
6742.6	55.8	56.2	55.6	55.1	56.4	56.4	56.9	53.2	52.1	51.5	45.3	41.1	37.3	37.8	25.6	149.281
6802.6	56.0	56.2	55.3	55.5	56.5	56.5	57.1	53.6	53.5	51.7	44.9	41.2	37.7	36.2	25.7	1.422
6862.7	55.8	56.5	55.3	55.5	56.6	56.5	57.0	53.6	53.9	51.5	45.1	41.2	37.9	34.7	25.6	2.533
6922.7	55.9	56.4	55.4	55.5	56.7	56.5	57.2	53.9	55.3	51.7	45.0	41.2	38.5	33.0	25.6	3.675
6982.7	55.9	56.4	55.4	55.5	56.9	56.6	57.2	53.7	55.8	51.4	45.0	41.1	38.1	32.9	25.6	4.811
7042.8	56.1	56.5	55.8	55.5	56.8	56.8	57.3	53.9	56.1	51.7	45.2	41.3	38.2	32.7	25.8	5.917
7102.8	56.0	56.4	55.5	55.6	57.0	56.7	57.2	53.8	56.0	51.6	45.1	41.1	37.9	32.3	25.6	7.050
7162.8	56.2	56.4	55.8	55.9	56.6	56.7	57.3	53.6	56.1	51.6	45.3	41.4	38.3	32.7	25.8	8.168
7222.9	56.0	56.4	55.6	55.4	57.2	56.6	57.1	53.3	55.7	51.7	45.1	41.1	38.5	32.5	25.7	9.308
7282.9	56.1	56.4	55.6	55.7	56.6	56.5	57.3	53.1	55.5	51.6	45.1	41.4	38.3	32.4	25.8	10.430

Grooved Plate Dryout Experiment Data Sheet Date: 30 Oct 92 Time: 1514 Run Designation: G1E4				
Runtime (min)	Amps	Volts	Comments	Dryout Length
			Groove is plugged; Power on; Groove full	
C1.0	2.238	26.15	Flow rate set 15 but coming down from T_{10}	
C3.2			Emptied flask	
C44.3			T_l=55 C Successful at drying out groove so that it couldn't rewet. And yet I put small squirt of ethanol in dried out end ⇒ it wouldn't dryout. this must be near $Q_{c,max}$.	
C53.3	2.222	26.09	SS at Q_{max} T_l=56	
C54.3	2.531	29.70	Upped power	
C68.3	2.528	29.69	Notice definitive front T_l=62	14cm
C79.3			Evaporative front. Seems SS T_l=65	25.4
C85.3	2.706	31.77	Upped power. Want to see boiling front. Fluid definitely recedes into groove!	
C103.3			T_l=69	28.7
C108.3	2.987	35.10	Upped power T_l=70	
C119.3			Swabbed out whole groove. T_l=74. It's hard to keep this groove clean because of small angle corners below metal surface	
C121.3			Front rewet quickly but spread out	29.31
C131.3	2.982	35.09	Δt=W-C=132.7 - 132.3=0.4 min T_l=77	32-34
C144.3			Changed flask	34

Grooved Plate Dryout Experiment Data Sheet

Date: 30 Oct 92 Time: 1514 Run Designation: G1E4

Runtime (min)	Amps	Volts	Comments	Dryout Length
C150.3			Just observed evidence of boiling - surface ripples. Bubbles are in corners under plate surface. T_7=73 T_9=70	35
C154.3			Squirted groove and cleaned it	34
W157.0			Power off	34-35
W159.5			Boiling at front across groove	29
W167.2			No more boiling	23
W169.2				17
W170.0				13
W170.4				9
W171.2				5
W172.2			T_1 = 49	1
C173.2	2.991	35.08	Groove rewet. Power back on	
C206.2	2.973	35.00	T_1=76 C	32cm
C219.2	2.976	35.03	T_1=78 C No sign of boiling	34
C224.2			SSSUM is steady T_1=78	34
C229.2			Boiling commenced in corners near front. Call this SS	33-35
C231.2			something to next page	
W233.0	2.183	25.68	Powered down to $Q_{c,max}$	34
W237.1			Boiling has stopped	29
W261.0	2.190	25.72		23
W271.4	2.193	25.72		17
W276.3				15
W278.2				13
W282.4				11

Grooved Plate Dryout Experiment Data Sheet

Date: 30 Oct 92 Time: 1514 Run Designation: GIE4

Runtime (min)	Amps	Volts	Comments	Dryout Length
W284.5	2.190	25.70	Computer interrupt at 283.4 T_1=58 C	9
W289.0			T_1=58 C	7
W296.5			T_1=58 C	5
W307.2			I give up!	3.7
310.3			Shutdown	

RUN LETTER DESIGNATION: G1E4
DATE: 10-03-1992 TIME: 15:18:46
GROOVE NUMBER: 1
THE RELATIVE HUMIDITY IS 28.92 MM OF MERCURY
THE FLOWMETER SETTING IS : 15
THE PLATE ANGLE IS 0

TIME IN SEC; SCALE IN GRAMS; T15 = 23 C

TIME	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	SCALE
60.5	22.4	22.2	22.3	22.4	23.2	22.2	22.1	22.2	24.3	22.5	22.2	20.8	21.9	18.9	21.8	175.253
83.8	22.5	22.3	22.7	22.7	23.6	22.4	23.0	23.0	24.3	23.5	22.7	21.1	21.8	19.7	21.8	176.222
143.8	23.6	23.3	23.9	24.0	25.1	24.1	24.3	24.9	25.2	25.2	23.5	22.0	21.9	20.4	21.8	178.597
167.0	23.9	23.8	24.4	24.5	25.7	24.7	24.8	25.7	26.2	25.8	24.0	22.6	22.0	20.5	21.7	179.457
226.9	25.4	25.3	26.0	26.1	27.5	26.6	25.9	27.3	27.0	27.4	25.1	23.8	22.5	21.5	21.7	1.811
249.9	25.9	26.0	26.4	26.8	28.4	27.4	26.7	28.0	27.5	27.8	25.3	24.1	22.6	22.0	21.8	2.609
309.8	27.6	27.4	28.2	28.4	30.3	29.1	28.4	29.5	28.1	29.2	26.3	25.1	23.0	22.6	21.5	4.553
333.2	28.2	28.3	28.9	29.1	31.0	29.9	29.1	30.1	28.8	29.5	26.6	25.3	23.2	22.9	21.9	5.301
393.2	30.0	29.9	30.7	30.8	32.8	31.6	30.4	31.7	29.6	30.9	27.7	26.5	23.7	23.9	21.7	7.204
416.3	30.4	30.4	31.1	31.5	32.1	32.3	32.3	31.7	29.7	31.2	27.8	26.7	24.0	23.6	21.7	7.898
476.3	31.8	31.9	32.7	32.9	32.9	33.7	33.7	32.8	31.0	32.4	28.8	28.0	24.4	25.1	22.0	9.701
499.2	32.5	32.4	33.2	33.4	33.0	34.4	34.2	33.3	31.6	32.8	29.0	28.2	24.4	25.2	21.9	10.375
559.2	33.9	32.8	33.6	35.0	35.9	35.4	35.5	34.5	31.9	33.8	30.0	28.5	25.1	25.1	21.8	12.044
582.5	34.5	33.5	34.5	35.4	35.1	36.4	36.0	34.8	32.3	34.3	30.0	29.3	25.3	26.1	21.9	12.668
642.6	35.9	36.0	36.7	36.9	35.4	37.9	37.3	36.2	34.2	35.4	31.2	30.7	26.0	26.9	21.7	14.281
665.6	36.3	36.5	37.2	37.3	35.9	38.3	37.8	36.6	33.9	35.7	31.3	31.0	26.0	27.4	21.7	14.868
725.6	37.7	37.9	38.4	38.4	36.2	39.2	38.7	37.5	35.0	36.5	31.8	31.9	26.6	27.9	21.6	16.415
748.5	38.3	38.4	38.8	38.9	36.6	39.8	39.3	37.9	35.1	36.9	32.4	32.3	26.8	28.3	21.7	16.997
808.5	39.6	39.4	40.2	39.8	37.1	41.1	40.3	38.9	36.2	37.8	32.9	33.0	27.3	29.0	21.8	18.536
831.9	39.9	39.9	40.5	40.4	37.3	41.4	40.7	39.2	36.2	38.1	33.2	33.5	27.6	29.3	21.7	19.133
891.9	41.1	40.9	41.5	41.4	38.2	42.4	41.6	40.2	37.2	38.8	33.7	34.3	27.9	30.1	21.7	20.672
914.9	41.4	41.4	42.0	41.9	38.4	42.8	42.0	40.6	37.4	39.1	34.0	34.5	28.0	30.2	21.8	21.244
974.9	42.3	42.4	42.9	42.7	39.1	43.8	43.0	41.4	38.3	40.0	34.8	35.1	28.5	30.8	21.8	22.799
1034.9	43.2	43.2	43.6	43.3	39.8	44.6	43.5	41.8	38.9	40.5	35.1	35.7	28.7	31.1	21.8	24.347
1094.9	44.1	44.1	44.7	44.3	40.5	45.5	44.5	42.7	39.3	41.1	35.6	36.7	28.3	32.2	21.9	25.902
1155.0	45.0	44.9	45.5	45.0	41.3	46.3	45.2	43.3	39.7	41.9	36.2	36.9	28.8	32.6	22.0	27.438
1215.0	45.8	45.6	46.0	45.6	41.9	46.9	45.9	44.0	40.5	42.5	36.7	37.7	29.2	32.9	21.8	29.010
1275.0	46.6	46.5	46.8	46.4	42.5	47.7	46.7	44.6	41.0	43.0	37.1	38.2	29.4	33.4	22.0	30.599
1335.1	47.3	46.9	47.7	47.0	43.1	48.2	47.3	45.3	41.6	43.6	37.6	38.4	29.9	34.1	22.0	32.163
1395.1	47.8	47.7	48.3	47.6	44.0	48.9	47.9	45.7	41.8	43.9	38.2	38.6	30.2	34.5	21.8	33.775
1455.1	48.1	48.2	48.5	48.1	44.1	49.3	48.3	45.8	42.0	44.4	38.4	39.4	29.9	34.5	21.9	35.368
1515.2	49.0	48.8	49.5	48.8	44.7	50.0	48.8	46.5	42.7	45.0	38.9	39.5	30.5	35.1	22.0	36.952
1575.2	49.5	49.5	49.8	49.0	44.9	50.4	49.4	46.9	43.2	45.3	39.0	39.9	30.9	35.6	21.8	38.451
1635.2	49.8	49.7	50.3	49.6	45.7	50.9	49.8	47.2	43.4	45.6	39.3	40.4	31.2	36.0	22.0	39.929
1695.3	50.3	50.3	50.7	50.1	45.9	51.4	50.2	47.6	43.8	46.1	39.6	40.3	31.4	36.0	22.0	41.327
1755.3	50.6	50.7	51.1	50.3	46.7	51.7	50.4	48.1	44.2	46.5	40.1	40.7	31.5	36.5	22.0	42.766
1815.3	51.2	51.0	51.7	51.0	47.2	52.2	51.1	48.4	44.2	46.8	40.1	41.1	32.1	36.8	22.0	44.186
1875.4	51.2	51.3	51.7	51.1	48.3	52.4	51.2	48.4	44.1	46.9	40.6	40.7	31.6	36.6	22.1	45.604
1935.4	51.8	51.9	52.3	51.5	47.7	52.9	51.6	49.0	45.0	47.3	40.6	41.3	32.0	36.9	22.1	46.985
1995.4	52.3	52.1	52.6	51.8	47.8	53.2	51.9	49.1	45.7	47.6	41.0	40.8	32.8	38.0	22.2	48.419
2055.5	52.6	52.4	52.8	52.3	49.1	53.6	52.3	49.6	45.6	48.0	41.1	40.6	33.1	37.9	22.2	49.853
2115.5	52.5	52.6	53.0	52.3	51.9	53.9	52.6	49.5	44.9	48.2	41.4	40.3	32.7	37.0	22.1	51.260

2175.5	52.8	50.1	48.9	52.4	53.3	53.9	52.8	50.0	44.5	48.6	41.7	40.3	33.0	37.3	22.3	52.677
2235.6	53.2	52.2	49.0	52.7	52.0	54.3	53.1	50.0	45.4	48.6	41.8	40.9	33.2	37.8	22.2	54.132
2295.6	53.4	53.2	52.0	53.2	53.6	54.6	53.3	50.5	44.7	48.9	42.2	41.1	33.6	37.8	22.5	55.544
2355.6	53.8	53.6	53.6	53.5	52.7	54.9	53.5	50.9	45.6	49.2	42.4	41.5	33.6	38.4	22.3	56.973
2415.7	54.1	54.0	54.0	53.6	53.5	55.1	53.8	50.6	45.1	49.1	42.1	41.3	33.0	38.1	22.4	58.439
2475.7	53.6	54.0	54.3	53.6	53.2	55.2	53.8	51.1	46.0	49.2	42.6	41.5	34.1	38.2	22.5	59.901
2535.8	54.0	54.2	49.6	53.5	53.0	55.1	54.0	50.8	46.0	49.5	42.4	41.9	33.1	38.6	22.5	61.304
2595.8	54.5	54.6	51.0	54.2	53.0	55.6	54.4	51.3	46.7	49.7	42.9	42.1	33.8	38.7	22.5	62.735
2655.8	54.5	54.8	53.8	52.2	58.0	55.6	54.3	51.4	44.2	49.7	42.8	40.7	33.8	37.1	22.5	64.155
2715.9	54.8	54.6	54.9	54.4	58.2	55.9	54.5	51.4	44.2	49.9	42.8	40.9	34.1	37.5	22.7	65.545
2775.9	54.8	54.8	55.2	54.6	58.4	55.9	54.8	51.6	44.7	50.3	43.3	41.1	34.0	37.3	22.7	66.916
2835.9	54.9	55.1	55.4	54.7	58.4	56.1	54.8	51.8	44.4	50.1	43.2	41.4	34.5	37.9	22.8	68.321
2895.9	55.2	55.3	55.5	54.8	58.6	56.2	55.0	51.7	44.9	50.3	43.5	41.3	33.9	37.7	22.8	69.671
2956.0	55.4	55.2	55.7	54.8	58.6	56.3	54.9	51.9	44.8	50.5	43.6	41.5	34.3	37.6	22.8	71.010
3016.0	55.6	55.8	55.9	55.0	58.8	56.4	55.0	52.3	44.8	50.5	43.7	41.7	34.7	38.5	23.0	72.362
3076.1	55.8	55.6	55.9	55.2	58.9	56.8	55.3	51.9	44.6	50.6	43.6	41.7	35.8	38.1	22.9	73.700
3136.1	55.7	55.6	56.2	55.3	59.1	56.5	55.1	52.4	44.9	50.8	43.8	41.5	35.8	38.1	23.0	75.013
3196.1	55.7	55.6	56.3	55.4	59.2	56.8	55.4	52.4	45.0	50.8	43.8	41.7	35.8	37.7	23.0	76.369
3256.2	55.9	56.2	56.2	55.6	59.3	56.8	55.5	52.4	44.8	50.8	44.1	41.7	35.8	38.3	23.0	77.664
3316.2	56.1	56.1	56.6	55.6	59.5	57.0	55.9	52.3	44.9	51.2	44.1	42.1	35.9	38.4	23.1	78.974
3376.2	56.6	56.5	56.9	56.0	60.0	57.6	56.4	53.3	45.2	51.9	44.5	42.3	36.1	38.4	23.0	80.309
3436.3	56.9	57.0	57.1	56.4	60.6	58.1	56.8	53.6	46.0	52.2	44.9	42.5	35.4	38.8	23.3	81.613
3496.3	57.2	57.3	57.9	57.0	61.0	58.7	57.3	54.0	46.1	52.6	45.0	43.0	35.2	39.4	23.2	82.905
3556.3	57.6	58.0	58.0	57.3	61.5	58.8	57.8	54.4	45.9	53.1	45.0	43.2	34.8	39.3	23.4	84.212
3616.4	58.5	58.8	58.8	58.2	62.1	59.7	58.6	55.4	46.7	53.4	45.9	43.1	36.9	39.3	23.3	85.533
3676.4	58.7	59.3	59.4	58.7	62.6	59.9	58.9	55.9	46.8	54.0	46.1	43.7	36.6	39.8	23.3	86.908
3736.4	59.4	59.8	60.0	59.2	63.2	60.6	59.2	56.5	47.5	54.2	46.5	43.7	37.0	39.9	23.4	88.257
3796.4	59.9	59.8	60.5	59.5	63.8	61.4	60.0	56.2	47.6	54.6	46.4	44.0	37.2	40.3	23.5	89.580
3856.5	60.4	60.3	60.9	59.8	64.0	61.5	60.1	56.7	48.0	54.8	46.7	44.0	37.4	40.3	23.5	90.899
3916.5	60.7	60.6	61.3	60.3	64.5	62.2	60.5	56.9	48.2	55.1	46.8	44.2	37.9	40.5	23.5	92.196
3976.6	60.9	61.2	61.6	60.7	64.9	62.4	61.1	57.3	48.6	55.4	47.2	44.7	37.4	40.6	23.6	93.499
4036.6	61.1	61.3	62.0	60.8	65.2	62.7	61.2	57.3	47.7	55.6	47.2	44.7	38.4	41.1	23.6	94.783
4096.6	61.7	61.8	62.3	61.1	65.7	63.0	61.3	57.7	48.7	56.0	47.7	45.2	38.3	41.2	23.7	96.032
4156.7	61.7	61.8	62.4	61.5	65.7	63.0	61.6	57.6	48.3	55.9	47.7	45.1	37.5	41.7	23.7	97.292
4216.7	61.9	62.4	63.0	61.7	66.1	63.4	61.9	58.4	49.8	56.3	48.0	43.1	39.3	42.1	23.8	98.554
4276.7	62.6	62.7	63.3	61.8	66.3	63.9	62.1	58.3	49.7	56.5	48.2	43.2	39.4	42.6	23.8	99.835
4336.8	62.9	62.7	63.5	62.3	66.6	63.9	62.6	58.5	50.2	56.5	48.1	43.4	40.0	42.4	24.0	101.079
4396.8	63.2	63.0	63.7	62.5	66.9	64.4	62.8	58.8	50.7	56.8	48.4	43.6	39.7	42.5	23.8	102.345
4456.8	63.3	63.4	63.9	62.7	67.1	64.3	62.7	59.3	50.2	57.0	48.8	43.7	40.4	43.2	24.0	103.618
4516.9	63.8	63.7	64.1	62.8	67.2	64.5	62.7	59.5	50.7	57.2	48.8	44.0	40.8	42.7	24.1	104.859
4576.9	63.9	63.6	64.2	63.1	67.6	64.9	63.4	59.1	50.2	57.4	48.7	44.1	41.3	42.9	24.0	106.138
4636.9	64.1	63.9	64.2	63.2	67.7	64.9	63.2	59.6	51.4	57.5	49.1	44.2	39.3	43.1	23.9	107.410
4696.9	64.0	64.2	64.5	63.2	67.8	65.1	63.3	59.6	52.0	57.6	48.9	44.3	37.7	44.0	24.0	108.643
4757.0	64.2	64.1	64.5	63.2	67.9	65.1	63.5	59.4	56.3	57.7	49.3	44.4	44.3	33.7	24.1	109.887
4817.0	64.0	64.1	64.8	63.4	67.9	65.0	63.7	59.7	57.1	57.8	49.4	44.5	43.7	33.8	24.3	111.164
4877.1	64.2	64.3	64.8	63.5	68.1	65.1	63.8	59.8	57.2	57.9	49.4	44.6	43.4	34.0	24.3	112.413
4937.1	64.3	64.2	64.8	63.7	68.3	65.5	64.2	59.8	56.9	58.0	49.6	44.7	44.3	34.1	24.3	113.657
4997.1	64.4	64.3	64.8	63.6	68.3	65.5	64.2	60.1	56.7	57.9	49.3	44.6	44.3	34.1	24.2	114.901
5057.2	64.3	64.7	64.8	63.5	68.3	65.6	64.3	60.0	56.5	58.0	49.7	45.0	45.2	34.1	24.4	116.137
5117.2	64.5	64.9	65.1	64.0	68.6	65.6	64.3	60.3	57.2	58.3	49.5	45.0	44.7	34.3	24.5	117.380

5177.2	64.9	64.9	65.2	64.1	68.8	66.0	64.4	59.8	57.5	58.3	49.7	45.1	45.0	34.4	24.4	118.642
5237.3	65.2	65.0	65.6	64.2	69.1	66.5	64.9	60.7	57.0	58.8	49.9	45.1	45.3	34.2	24.5	119.921
5297.3	65.5	65.7	65.9	64.8	69.5	66.7	65.3	61.0	57.2	59.2	50.4	45.5	45.4	34.4	24.6	121.158
5357.3	65.9	65.6	66.3	65.0	69.9	67.1	65.6	61.5	57.3	59.5	50.4	45.7	45.9	34.9	24.5	122.420
5417.4	66.2	66.2	66.5	65.7	70.2	67.4	65.9	61.9	57.7	59.8	51.1	45.9	45.8	35.0	24.6	123.711
5477.4	66.7	66.4	67.0	66.1	70.7	67.7	66.4	61.8	58.4	60.1	51.1	46.2	45.8	34.9	24.6	124.957
5537.4	66.6	66.9	67.3	66.2	70.8	67.8	66.3	62.1	58.2	60.2	51.2	46.2	46.3	35.2	24.4	126.176
5597.5	67.3	67.2	67.7	66.3	71.2	68.2	66.6	62.1	59.1	60.5	51.4	46.4	45.5	35.2	24.7	127.390
5657.5	67.3	67.6	67.9	66.7	[illegible]	68.6	67.2	62.9	58.6	61.0	51.6	46.8	46.2	35.3	24.7	128.617
5717.5	67.5	67.7	68.2	67.1	71.7	68.4	67.3	63.2	60.1	60.8	51.9	46.8	46.0	35.5	24.9	129.8[illegible]
5777.6	67.7	68.1	68.4	67.1	71.9	69.0	67.4	63.1	59.4	61.2	51.9	47.0	46.2	35.5	24.9	131.031
5837.6	68.1	68.3	68.5	67.4	72.2	69.2	67.8	63.4	59.7	61.4	52.1	47.1	46.4	35.6	25.0	132.242
5897.6	68.1	68.8	68.8	67.5	72.4	69.5	68.1	63.7	60.5	61.4	52.3	47.2	46.1	35.9	25.1	133.444
5957.7	68.3	68.9	69.0	67.7	72.7	69.7	68.2	64.3	59.9	61.7	52.3	47.3	46.5	35.9	25.1	134.656
6017.7	68.6	68.9	69.4	68.3	72.9	70.3	68.3	63.9	60.4	61.9	52.3	47.3	47.0	35.5	25.1	135.839
6077.7	68.8	69.2	69.4	68.3	73.2	69.9	68.4	63.6	60.8	61.9	52.7	47.5	47.5	36.1	25.2	137.025
6137.8	69.0	68.9	69.6	68.3	73.1	70.0	68.6	64.3	60.6	61.9	52.8	47.7	47.4	36.0	25.2	138.204
6197.8	69.0	69.2	69.6	68.5	73.2	70.3	68.7	64.0	61.2	62.2	52.7	47.5	46.8	36.0	25.2	139.383
6257.8	69.0	69.2	69.8	68.3	73.5	70.6	68.9	64.0	61.2	62.0	52.8	47.8	46.9	36.1	25.2	140.564
6317.9	68.3	68.6	68.7	68.4	73.6	70.5	68.9	64.6	59.4	62.1	52.6	47.9	47.6	36.4	25.5	141.726
6377.9	69.1	69.8	70.0	69.0	73.6	70.9	69.2	64.2	61.1	62.4	52.8	47.8	47.3	36.4	25.2	142.869
6437.9	69.4	69.7	70.1	68.7	73.8	70.6	69.1	64.6	60.4	62.3	53.0	47.9	48.0	35.9	25.2	144.019
6498.0	69.2	69.6	70.1	69.0	73.8	70.5	69.1	64.8	59.8	62.5	52.8	47.9	48.4	36.6	25.5	145.130
6558.0	69.6	70.0	70.4	68.9	73.9	70.9	69.1	64.5	59.6	62.7	53.0	48.0	48.2	36.4	25.5	146.274
6618.0	70.0	70.2	70.8	69.2	74.4	71.3	69.7	65.2	60.7	63.4	53.3	48.4	49.0	36.7	25.6	147.402
6678.1	70.5	70.5	71.0	70.0	74.9	72.0	70.3	65.6	60.5	63.6	53.7	48.5	49.6	36.6	25.5	148.559
6738.1	70.8	71.0	71.4	70.1	75.1	71.9	70.7	65.9	60.6	63.9	54.1	48.6	49.6	36.4	25.6	149.665
6798.1	71.0	71.4	71.6	70.2	75.5	72.4	70.6	66.6	60.5	64.1	54.4	49.0	49.9	37.0	25.5	150.803
6858.2	71.2	71.9	72.2	70.7	76.0	72.7	71.2	66.6	61.1	64.8	54.5	49.2	50.6	37.1	25.8	151.938
6918.2	72.0	72.2	72.5	71.3	76.6	73.6	71.9	67.0	60.4	65.0	54.7	49.1	50.8	37.0	25.6	153.083
6978.2	72.1	72.7	72.9	71.9	76.9	73.9	72.2	67.7	61.0	65.5	55.0	49.6	50.7	37.4	25.7	154.226
7038.3	72.7	73.2	73.7	72.3	77.4	74.1	72.7	68.1	62.3	65.5	55.4	49.8	51.5	37.5	25.8	155.383
7098.3	72.7	73.5	74.1	72.5	78.0	75.0	73.1	67.8	61.3	65.9	55.4	49.9	52.0	37.6	25.8	156.500
7158.3	73.4	73.7	74.4	72.8	78.3	75.4	74.1	69.5	62.3	65.9	55.7	50.2	52.2	37.6	25.8	157.671
7218.4	73.9	73.8	74.7	73.3	78.7	75.7	74.3	69.7	57.0	66.0	54.7	48.4	51.1	37.6	26.1	158.790
7278.4	74.1	74.3	74.9	73.5	78.8	75.7	74.3	70.3	62.3	66.2	56.1	50.3	52.6	37.6	25.9	159.833
7338.4	74.8	74.8	75.6	73.9	79.3	76.2	75.1	70.2	62.9	66.8	56.6	50.5	53.5	37.9	26.0	160.775
7398.5	74.7	75.1	75.6	74.0	79.5	76.3	75.4	70.7	62.3	67.3	56.3	50.8	53.3	38.1	26.1	161.763
7458.5	75.1	75.4	75.9	74.0	79.8	76.7	75.3	70.5	62.4	67.2	56.6	51.0	53.5	38.3	26.1	162.753
7518.5	75.2	75.3	76.3	74.9	80.2	77.1	75.8	71.1	62.4	67.3	56.8	51.1	53.7	38.3	26.2	163.749
7578.6	75.6	75.9	76.2	74.6	80.3	77.3	75.9	71.0	63.0	67.9	56.8	51.3	53.7	38.7	26.2	164.769
7638.6	75.9	76.1	76.9	75.0	80.6	77.3	76.2	71.1	63.5	68.2	56.9	51.6	53.9	38.7	26.2	165.813
7698.6	76.3	76.5	77.1	75.4	80.8	77.5	76.6	71.8	62.6	68.3	57.3	51.7	54.6	39.1	26.3	166.849
7758.7	76.0	76.7	77.2	75.5	81.0	77.6	76.4	71.4	63.0	68.2	57.6	51.9	54.4	39.2	26.3	167.914
7818.7	76.6	76.8	77.1	75.8	81.4	77.8	76.5	72.3	63.2	68.3	57.6	51.9	55.1	38.9	26.2	168.958
7878.7	76.4	76.9	77.5	75.7	81.5	77.8	76.9	71.4	62.9	68.5	57.7	51.9	54.6	38.7	26.5	169.996
7938.8	76.3	77.3	77.5	75.6	81.5	78.4	76.8	72.2	63.9	68.6	57.9	52.0	55.1	39.2	26.5	171.039
7998.8	77.1	77.3	77.6	76.1	81.7	78.6	77.4	72.1	63.7	68.7	57.8	52.2	54.7	39.3	26.5	172.102
8058.8	77.2	77.3	78.1	76.4	82.1	79.1	77.7	72.3	64.2	68.9	57.8	52.2	55.1	39.4	26.5	173.159
8118.9	77.1	77.7	77.9	76.7	82.1	79.0	77.8	72.8	63.3	69.2	58.3	52.5	55.8	39.6	26.5	174.203

8178.9	77.1	77.9	77.9	76.6	82.2	78.7	77.4	73.2	64.2	69.1	58.4	52.6	55.5	39.4	26.5	175.282
8238.9	77.8	78.1	78.1	76.7	82.4	79.1	77.9	73.4	63.5	69.2	58.3	52.8	55.3	39.5	26.8	176.352
8299.0	78.1	77.9	78.5	77.1	82.7	79.3	78.0	73.4	64.4	69.3	58.5	52.9	55.6	40.0	26.7	177.411
8359.0	77.8	78.5	78.6	77.1	82.7	79.4	78.2	73.0	63.7	69.5	58.8	52.9	55.5	39.7	26.8	178.498
8419.0	77.9	78.5	78.7	77.1	82.9	79.4	78.4	73.2	63.6	69.7	58.9	53.1	56.0	40.1	26.8	179.578
8479.1	78.1	78.4	78.8	77.1	83.1	79.6	78.6	73.4	64.6	69.9	58.8	53.0	56.0	40.1	26.8	180.658
8539.1	78.3	78.8	78.8	77.2	83.1	79.5	78.4	73.6	63.5	69.8	59.0	53.1	56.5	40.0	27.0	181.706
8599.1	78.3	78.6	79.1	77.3	83.1	79.6	78.4	73.0	63.6	69.5	58.9	53.2	56.7	40.1	26.8	182.784
8659.2	78.3	78.3	79.3	77.7	83.4	80.4	79.0	74.0	63.7	69.9	59.0	53.2	57.2	40.1	27.1	183.858
8719.2	78.3	78.9	79.1	77.1	83.3	79.9	78.9	73.5	63.6	70.0	59.3	53.4	57.6	40.2	27.0	1.779
8779.2	78.4	78.4	79.4	77.8	83.5	80.5	79.1	74.1	64.0	70.0	59.1	53.5	57.2	40.5	26.9	2.845
8839.3	78.3	78.7	79.3	77.9	83.5	80.3	79.0	73.9	63.7	70.1	59.2	53.7	57.3	40.5	27.1	3.927
8899.3	78.4	78.5	79.5	77.7	83.6	80.6	79.2	73.9	63.5	70.1	59.2	53.6	57.7	40.6	27.0	4.971
8959.3	78.7	78.7	79.7	77.7	83.4	80.1	79.0	74.0	64.3	70.1	59.3	53.7	57.2	40.6	27.1	6.051
9019.4	78.4	78.9	79.6	77.9	83.7	80.5	79.3	74.2	64.0	70.2	59.4	53.6	57.6	40.6	27.3	7.120
9079.4	77.8	78.5	78.4	77.2	83.5	79.9	78.9	73.3	63.4	70.2	59.2	53.4	57.4	40.3	27.1	8.159
9139.4	78.5	78.7	79.8	78.0	83.7	80.5	79.3	74.1	63.7	70.3	59.4	53.8	58.1	40.7	27.2	9.222
9199.5	78.5	78.7	79.8	77.9	83.9	81.0	79.7	74.1	64.2	70.6	59.3	53.7	57.4	40.6	27.3	10.272
9259.5	78.9	78.4	79.7	78.4	84.0	81.2	79.7	74.0	63.9	70.4	59.5	53.7	57.2	40.9	27.4	11.255
9319.5	78.7	78.8	80.2	78.3	83.8	80.8	79.8	74.5	63.8	70.2	59.2	53.9	57.4	40.3	27.3	12.225
9379.6	79.1	79.3	80.0	77.9	83.9	80.4	79.5	74.4	63.7	70.5	59.7	53.9	58.6	40.6	27.4	13.224
9439.6	78.9	79.1	80.2	78.3	83.9	80.9	79.7	74.2	64.2	70.2	59.2	54.0	57.6	40.9	27.3	14.236
9499.6	78.4	78.0	79.3	77.5	83.1	79.9	78.6	73.0	63.1	68.0	57.8	53.4	57.0	40.8	27.6	15.235
9559.6	77.3	76.8	77.8	75.8	81.3	78.0	76.7	70.1	61.8	65.7	56.5	53.0	55.8	40.7	27.6	16.249
9582.6	76.4	76.3	76.8	75.0	80.4	77.4	75.8	69.3	61.1	64.7	55.9	52.5	55.1	40.6	27.5	16.645
9642.6	74.7	74.4	75.1	72.8	78.3	74.5	73.0	67.6	59.6	62.7	54.9	51.8	53.4	40.4	27.8	17.656
9665.9	74.0	73.8	73.9	71.7	77.0	73.4	72.0	66.3	59.1	61.9	54.4	51.3	53.1	40.5	27.7	18.056
9725.9	71.8	71.4	71.8	69.5	74.4	70.7	69.2	63.7	57.6	60.1	53.3	50.3	51.8	40.1	27.6	19.057
9749.0	70.9	70.5	71.1	68.9	73.5	69.9	68.6	63.5	57.0	59.7	52.9	50.0	51.0	40.1	27.7	19.446
9809.0	68.9	68.4	68.7	66.6	70.8	67.4	65.9	61.3	56.1	58.0	51.5	49.2	49.7	39.6	27.8	20.458
9831.9	68.1	67.5	67.9	65.6	69.8	66.5	65.0	60.4	55.6	57.4	51.2	48.7	49.6	39.3	27.9	20.853
9891.9	65.7	65.6	65.7	63.5	67.4	64.0	62.7	58.6	54.3	55.9	50.2	47.9	48.2	39.2	27.8	21.840
9915.3	65.2	64.6	64.8	62.4	66.4	63.3	61.9	57.7	54.0	55.4	49.7	47.4	47.9	38.8	28.0	22.210
9975.2	62.9	62.4	62.5	60.7	64.2	61.3	59.8	56.0	53.0	53.7	48.5	46.7	46.7	38.2	27.8	23.198
9998.3	62.2	61.8	61.7	59.6	63.2	60.2	59.1	55.2	52.7	53.4	48.3	46.4	46.0	38.2	27.9	23.574
10058.3	60.2	59.9	59.5	57.6	61.0	58.3	57.1	53.8	53.1	52.1	47.2	45.4	43.5	37.4	27.8	24.537
10081.2	59.6	58.9	58.8	56.9	60.4	57.6	56.5	53.2	55.1	51.5	46.7	45.1	40.1	37.7	28.0	24.910
10141.2	57.5	57.1	56.9	55.4	58.6	55.7	54.8	51.7	53.8	50.4	45.9	44.1	40.1	36.9	27.9	25.840
10164.6	56.8	56.3	56.2	54.5	57.9	55.2	54.1	51.3	53.2	49.9	45.5	43.9	39.6	36.6	28.0	26.209
10224.6	55.1	54.7	54.7	52.9	56.2	53.5	52.6	49.9	52.0	48.7	44.6	43.1	38.9	36.3	28.0	27.161
10247.6	54.5	54.1	53.9	52.4	55.6	52.8	52.0	49.4	51.6	48.2	44.2	42.8	38.8	36.2	28.0	27.514
10307.6	53.1	52.5	52.5	51.0	54.0	51.4	50.6	48.1	50.6	47.3	43.5	42.0	38.0	35.6	27.9	28.445
10330.6	52.3	51.8	51.8	50.5	53.4	51.0	50.3	47.8	50.1	46.9	43.0	41.7	37.7	35.5	28.0	28.815
10390.5	51.1	50.4	50.5	49.2	52.0	49.5	48.8	46.6	45.6	45.7	42.4	41.0	37.2	38.7	28.1	29.737
10413.9	48.9	47.8	48.6	48.6	51.4	49.1	48.4	46.0	45.0	45.5	42.0	40.8	37.5	38.8	28.2	30.088
10437.2	49.9	49.2	49.5	48.3	51.0	48.6	48.0	46.1	45.1	45.7	42.1	40.4	37.1	38.4	28.1	30.427
10460.2	49.7	49.3	49.6	48.4	51.1	48.7	48.5	46.6	44.8	46.8	42.2	40.3	36.8	39.3	28.2	30.796
10520.2	49.9	49.7	50.2	49.1	51.8	49.8	49.7	48.2	45.8	48.7	43.5	40.4	36.8	39.3	28.3	31.696
10580.2	50.4	47.5	50.8	47.4	53.0	51.0	51.1	49.5	47.5	50.1	44.4	40.7	36.7	39.7	28.2	32.501
10640.3	51.4	50.9	52.2	51.4	54.4	52.4	52.5	50.8	47.0	51.4	45.0	41.1	37.1	40.8	28.1	33.493

10663.4	51.6	51.5	52.3	52.6	55.1	52.8	53.0	50.9	47.8	51.7	45.2	41.0	36.3	40.4	28.1	33.837
10723.4	52.8	52.8	53.7	53.4	56.5	54.5	54.7	52.7	48.6	52.6	45.8	41.6	36.8	41.7	28.1	34.731
10746.3	53.4	53.5	54.4	53.9	57.0	54.7	55.1	53.1	49.3	53.1	46.2	41.9	36.6	41.5	28.2	35.095
10806.4	54.7	54.9	55.8	55.5	58.7	56.6	56.5	54.6	49.2	54.1	46.8	42.4	36.9	42.6	28.1	36.003
10829.7	55.1	55.4	56.4	56.0	59.2	57.3	57.4	54.9	49.4	54.6	46.8	42.4	37.5	42.4	28.1	36.358
10889.8	56.5	56.5	57.5	57.3	60.8	58.7	58.6	56.1	50.7	55.3	47.6	43.0	37.7	43.5	28.2	37.298
10912.8	57.0	57.4	57.9	57.7	61.3	59.1	59.6	56.2	51.6	56.0	47.8	43.3	37.8	43.2	28.3	37.653
10972.7	58.5	58.5	59.5	59.0	62.7	60.6	60.5	57.8	51.7	56.5	48.2	43.7	38.2	44.0	28.2	38.603
10995.6	58.9	58.7	60.2	59.4	63.3	61.1	61.0	58.3	51.7	56.9	48.5	43.8	37.8	44.0	28.2	38.978
11055.7	60.1	60.3	61.2	60.4	64.6	62.0	62.3	59.1	52.5	57.6	49.4	44.4	37.8	44.5	28.2	39.946
11079.0	60.7	60.8	61.7	61.1	64.9	62.7	62.6	59.7	52.1	57.9	49.6	44.5	38.0	45.0	28.2	40.344
11139.1	61.9	61.8	63.2	62.1	66.3	63.9	63.7	60.7	53.7	58.6	50.1	44.9	38.6	45.3	28.2	41.336
11162.1	62.2	62.5	63.6	63.1	66.7	64.5	64.3	60.8	53.7	59.0	50.3	45.3	38.6	45.5	28.2	41.713
11222.1	63.6	63.5	64.8	63.8	67.9	65.5	65.2	61.9	53.9	59.8	50.6	45.5	39.4	45.9	28.2	42.729
11245.0	64.0	64.1	65.1	64.2	68.3	65.7	65.6	61.8	54.0	60.0	51.1	45.9	39.0	46.7	28.1	43.131
11305.0	65.1	65.0	66.3	65.3	69.4	66.7	66.3	63.1	55.0	60.6	51.3	46.2	39.3	46.5	28.1	44.148
11328.3	65.5	65.6	66.5	65.6	69.6	67.0	66.8	63.0	55.3	60.9	51.6	46.4	39.7	46.7	28.1	44.533
11388.3	66.3	66.6	67.3	66.4	70.8	67.9	67.6	63.8	55.8	61.4	52.1	46.8	39.9	47.2	28.1	45.590
11448.3	67.3	67.3	68.4	67.2	71.5	68.8	68.3	64.5	55.3	61.9	52.5	47.2	39.7	47.7	28.4	46.650
11508.4	68.1	68.3	69.2	68.3	72.5	69.5	69.3	65.0	56.3	62.7	53.0	47.6	40.4	48.2	28.2	47.697
11568.4	68.9	69.1	69.8	69.0	73.3	70.4	69.9	65.7	56.6	63.1	53.4	47.9	41.0	48.8	28.2	48.760
11628.4	69.3	69.8	70.6	69.4	73.9	70.9	70.4	66.3	56.9	63.3	53.7	48.2	40.7	48.8	28.1	49.840
11688.5	70.4	70.4	71.1	70.2	74.7	71.8	71.1	66.6	58.0	63.8	53.8	48.6	41.1	48.7	28.2	50.907
11711.8	70.4	70.7	71.4	70.4	75.0	71.6	71.2	66.9	57.2	64.0	54.2	48.7	41.6	49.6	28.2	51.309
11771.8	70.9	70.6	72.4	70.9	75.5	72.6	71.8	67.4	58.4	64.4	54.4	49.0	41.2	49.1	28.1	52.369
11831.9	71.5	71.3	73.1	71.7	76.3	73.5	72.4	67.7	58.5	64.8	54.7	49.2	41.7	49.5	28.2	53.446
11891.9	72.1	72.2	73.3	72.0	76.5	73.5	72.7	68.0	58.3	65.1	55.0	49.3	41.9	50.1	28.1	54.474
11951.9	72.7	72.4	73.6	72.5	77.1	74.1	73.2	68.8	58.5	65.6	55.1	49.6	41.3	50.3	28.2	55.531
12012.0	73.1	73.2	74.0	72.7	77.6	74.3	73.6	69.0	59.7	65.7	55.4	49.9	42.2	50.3	28.2	56.596
12072.0	73.6	73.5	74.5	73.5	78.1	74.9	74.1	69.1	59.7	66.4	55.8	50.3	42.1	50.2	28.1	57.639
12132.1	74.0	74.1	74.9	73.8	78.4	75.0	74.2	69.7	59.7	66.4	56.0	50.5	42.7	50.9	28.2	58.703
12192.1	74.5	74.3	75.2	74.0	78.7	76.0	75.1	70.0	59.7	66.8	55.9	50.5	42.5	51.1	28.2	59.766
12252.1	74.8	74.9	75.8	74.4	79.3	76.0	75.3	69.9	59.7	66.6	56.3	50.7	42.8	51.3	28.2	60.920
12312.2	75.2	74.7	76.4	74.9	79.6	76.5	75.6	70.1	60.4	67.3	56.8	51.0	43.0	51.8	28.2	61.872
12372.2	75.4	75.4	76.2	74.8	80.0	76.3	75.9	69.7	60.4	67.7	56.7	51.3	43.0	51.9	28.2	62.933
12432.2	75.6	75.7	76.6	75.3	80.3	76.9	76.1	71.0	60.0	67.6	56.7	51.4	43.4	51.7	28.2	63.973
12492.3	75.8	76.2	77.1	75.5	80.5	77.3	76.4	71.6	60.7	67.8	57.0	51.6	43.5	52.1	28.2	65.002
12552.3	75.9	76.2	77.0	76.0	80.8	77.8	76.7	71.9	60.8	68.0	57.2	51.5	43.1	52.1	28.2	66.037
12612.3	76.4	75.9	77.7	76.0	81.0	77.9	76.9	71.2	61.3	68.3	57.2	51.7	43.0	51.9	28.2	67.070
12672.3	76.8	76.2	77.4	76.4	81.1	77.9	77.0	71.4	61.0	68.5	57.4	51.9	43.4	52.6	28.2	68.099
12732.4	77.1	76.4	77.7	76.2	81.3	78.2	77.1	71.9	61.3	68.6	57.7	52.2	43.8	52.3	28.2	69.138
12792.4	77.0	77.2	77.9	76.6	81.4	78.2	77.3	72.1	61.5	68.6	57.7	52.3	44.3	52.7	28.2	70.191
12852.5	77.2	77.4	78.3	77.0	82.0	78.5	77.4	71.7	61.1	68.8	57.7	52.2	43.8	52.9	28.2	71.223
12912.5	77.0	77.5	78.0	77.0	81.9	78.8	77.8	72.9	62.3	68.9	58.6	52.5	44.3	52.6	28.3	72.229
12972.5	77.2	77.8	78.2	77.4	82.2	78.6	78.1	72.2	62.0	69.5	58.3	52.6	44.8	52.3	28.3	73.252
13032.6	77.4	77.7	78.4	77.6	82.2	79.0	78.4	72.7	61.5	69.5	58.6	52.7	44.4	53.3	28.5	74.284
13092.6	77.3	77.6	78.2	77.4	82.2	79.2	78.3	73.6	61.9	69.7	58.6	52.7	44.3	52.9	28.3	75.273
13152.6	77.3	78.1	78.2	77.3	82.4	78.9	78.2	72.6	62.3	69.4	58.4	52.6	44.0	52.8	28.4	76.278
13212.7	77.4	77.8	78.2	77.0	82.3	78.7	78.2	72.0	61.6	69.2	58.4	52.7	43.5	52.9	28.4	77.273
13272.7	77.6	78.1	78.1	77.3	82.3	79.0	78.3	73.4	62.3	69.4	58.8	52.9	44.7	52.9	28.3	78.265

13332.7	77.7	77.8	78.4	77.3	82.5	78.9	78.5	72.4	62.2	69.6	59.1	52.9	44.7	53.0	28.4	79.261
13392.8	77.7	78.0	78.6	77.7	82.6	78.9	78.5	72.4	61.7	69.8	58.8	53.0	44.5	52.8	28.5	80.266
13452.8	77.6	78.2	78.5	77.8	82.5	79.4	78.7	73.4	62.4	70.0	59.0	53.2	44.2	53.1	28.5	81.282
13512.8	78.0	78.3	78.8	77.5	82.4	79.3	78.6	72.8	63.3	69.9	59.3	53.1	44.7	52.7	28.4	82.284
13572.9	77.6	78.3	78.7	77.6	82.7	79.6	78.5	72.8	62.9	70.4	59.5	53.3	44.9	52.9	28.5	83.302
13632.9	77.8	77.8	78.8	77.8	82.9	79.9	78.9	74.1	62.9	70.2	59.2	53.5	45.0	53.3	28.5	84.343
13692.9	77.9	78.5	78.9	77.9	82.8	79.6	78.8	72.8	63.5	70.3	59.5	53.4	45.2	52.8	28.5	85.363
13753.0	78.0	78.3	79.0	78.4	83.1	80.1	79.1	73.7	63.8	70.4	59.1	53.5	45.3	53.3	28.6	86.401
13813.0	77.9	78.1	79.1	77.9	82.8	79.8	78.8	73.3	64.0	70.4	59.4	53.6	45.2	53.2	28.6	87.439
13873.0	78.1	78.3	78.9	78.1	83.1	79.9	79.1	73.9	62.9	70.6	59.7	53.7	45.2	53.9	28.7	88.430
13933.1	78.1	78.4	79.1	78.4	83.3	80.0	79.0	73.9	63.0	70.2	59.6	53.9	45.2	54.6	28.6	89.337
13993.1	78.1	78.2	79.5	77.9	83.0	79.9	79.0	73.1	60.7	70.6	59.8	53.9	49.5	52.5	28.8	90.242
14053.1	78.1	77.9	78.7	77.9	82.8	79.4	78.9	72.8	60.5	69.7	59.1	53.7	49.3	52.3	28.6	91.188
14113.2	77.7	77.7	78.1	76.9	82.0	78.5	78.0	71.9	59.9	68.4	58.6	53.5	48.9	51.8	28.8	92.108
14173.2	76.9	77.0	77.5	76.1	81.0	77.4	77.0	71.4	59.6	67.5	57.7	53.2	48.7	51.6	28.8	93.041
14233.2	76.2	76.1	76.3	75.0	80.0	76.7	75.7	70.3	58.8	66.4	57.3	52.6	48.4	51.0	28.5	93.984
14293.3	75.2	75.4	75.1	74.4	78.9	75.6	74.6	69.4	58.6	66.0	56.6	52.2	47.9	50.8	28.7	94.917
14316.6	74.8	74.8	75.0	74.1	78.5	75.6	74.3	68.9	58.2	65.6	56.5	52.1	48.0	50.1	28.8	95.305
14376.6	74.0	73.8	74.3	73.2	77.5	74.5	73.2	67.5	57.7	65.1	56.1	51.7	47.4	50.0	28.8	96.251
14436.6	72.9	73.1	72.8	72.1	76.6	73.3	72.3	67.1	57.6	64.5	55.5	51.3	47.2	49.7	28.8	97.199
14459.9	72.7	72.4	72.6	71.6	76.0	72.9	71.8	66.4	56.7	64.2	55.6	51.2	46.7	49.0	28.8	97.541
14519.9	71.8	71.7	72.0	70.8	75.2	71.8	70.9	65.9	56.7	63.7	55.1	50.8	45.7	49.1	28.8	98.499
14579.9	70.9	71.0	71.1	70.3	74.2	71.1	70.1	65.3	57.8	63.0	54.7	50.4	43.9	49.8	28.8	99.459
14639.9	70.4	69.9	70.5	69.2	73.3	70.1	69.1	64.3	56.8	62.5	54.4	50.0	43.5	49.2	28.8	100.399
14700.0	69.3	69.2	69.6	68.5	72.5	69.1	68.5	63.3	55.9	61.9	53.9	49.5	43.1	49.0	28.7	101.323
14723.3	69.2	68.9	69.3	68.3	72.1	68.9	68.3	63.4	56.9	61.8	53.7	49.6	43.2	48.6	28.8	101.695
14783.4	68.3	68.1	68.6	67.5	71.5	68.5	67.5	62.9	56.1	61.3	53.3	49.3	42.8	48.9	28.8	102.641
14843.4	67.5	67.8	68.1	67.1	70.8	67.6	67.2	62.2	55.7	61.0	53.0	48.9	42.6	48.3	28.8	103.563
14903.4	67.1	66.9	67.4	66.5	70.0	67.3	66.4	61.9	55.3	60.4	52.7	48.7	42.5	47.8	28.8	104.484
14963.5	66.2	66.0	66.4	65.6	69.5	66.2	65.7	61.7	54.7	59.8	52.3	48.4	42.2	48.1	28.7	105.398
15023.5	65.6	65.3	65.8	65.1	68.9	66.2	65.1	61.2	55.2	59.5	52.0	48.2	41.7	47.0	29.0	106.335
15083.5	65.2	64.9	65.5	64.5	68.1	65.1	64.8	59.9	54.2	59.2	51.9	47.7	42.0	47.2	28.9	107.267
15143.6	64.6	64.2	64.8	64.0	67.7	64.8	64.1	59.6	53.8	58.5	51.3	47.5	41.7	46.7	29.1	108.189
15203.6	64.0	63.7	64.6	63.4	67.2	64.2	63.9	59.8	54.1	58.5	51.1	47.2	41.3	46.5	28.9	109.106
15263.6	63.4	63.6	63.9	63.1	66.8	63.8	63.4	59.4	53.7	58.1	50.9	47.0	40.8	45.7	29.0	110.035
15323.7	63.2	62.8	63.7	62.6	66.3	63.7	63.2	59.2	53.8	57.9	50.8	46.9	41.2	46.1	29.1	110.963
15383.7	63.0	62.5	63.0	62.6	65.9	63.5	62.7	58.4	52.8	57.7	50.4	46.7	40.8	45.8	29.0	111.871
15443.7	62.3	62.2	62.7	61.8	65.6	62.9	62.2	58.4	53.2	57.3	50.2	46.3	40.6	45.6	29.0	112.802
15503.8	62.0	61.9	62.5	61.7	65.2	62.6	62.0	58.2	52.3	57.0	50.0	46.1	40.4	45.6	29.0	113.722
15563.8	61.7	61.6	62.1	61.6	64.8	62.5	61.5	57.7	52.4	56.8	50.0	46.1	40.2	45.4	29.0	114.650
15623.8	61.5	61.2	61.8	61.1	64.6	61.9	61.5	57.5	52.3	56.6	49.6	45.7	40.1	45.0	28.9	115.575
15683.9	61.3	61.2	61.6	60.9	64.2	61.4	61.2	57.2	52.4	56.6	49.3	45.7	39.9	44.7	29.1	116.497
15743.9	60.8	60.8	61.0	60.6	63.9	61.6	60.8	57.2	52.4	56.2	49.2	45.5	40.1	44.5	29.1	117.395
15803.9	60.4	60.4	61.0	60.2	63.7	61.2	60.9	57.0	51.5	55.9	49.1	45.3	39.7	44.6	29.0	118.328
15864.0	60.1	60.0	60.8	60.0	63.4	60.9	60.5	56.5	51.4	55.9	49.0	45.2	39.5	44.2	29.3	119.241
15924.0	60.2	59.9	60.6	60.0	63.3	60.6	60.3	56.6	51.9	55.6	48.8	45.2	39.5	44.1	29.1	120.173
15984.0	59.9	59.7	60.1	59.6	63.0	60.2	59.9	56.1	51.3	55.5	48.6	44.7	39.5	44.5	29.3	121.064
16044.1	59.5	59.7	60.2	59.5	62.8	60.4	60.1	56.5	51.2	55.2	48.8	44.7	39.2	44.1	29.2	122.003
16104.1	59.5	59.2	59.9	59.2	62.5	60.2	59.5	56.1	50.8	55.3	48.7	44.6	39.0	44.0	29.0	122.925
16164.1	59.4	59.2	59.8	59.1	62.4	59.8	59.6	55.8	51.2	55.1	48.3	44.5	39.3	43.8	29.1	123.890

16224.2	59.2	59.0	59.5	58.8	62.2	59.8	59.1	55.9	50.6	54.9	48.4	44.5	39.0	43.6	29.0	124.868
16284.2	58.7	58.5	59.5	58.8	61.9	59.3	59.1	55.3	50.4	54.8	48.0	44.4	39.1	43.6	28.9	125.844
16344.2	58.8	58.8	59.3	58.8	62.0	59.4	58.9	55.4	50.2	54.6	47.8	44.1	38.9	43.3	29.2	126.856
16404.3	58.6	58.4	59.1	58.8	61.7	59.2	58.7	55.2	50.5	54.5	47.7	44.1	38.8	43.3	29.1	127.862
16464.3	58.8	58.5	58.8	58.6	61.9	59.2	58.8	55.0	50.1	54.5	47.8	44.0	38.7	43.1	29.1	128.874
16524.3	58.2	58.2	58.7	58.5	61.4	58.8	58.6	55.1	49.9	54.4	47.9	43.9	38.6	43.0	29.0	129.890
16584.4	58.5	58.0	58.9	58.4	61.3	59.2	58.5	55.5	50.6	54.2	47.6	44.0	38.9	42.8	29.1	130.929
16644.4	57.9	57.7	58.6	57.9	61.2	58.8	58.4	55.3	49.7	54.1	47.4	43.6	38.3	43.0	29.0	131.953
16704.4	57.9	58.0	58.5	58.5	61.0	58.5	58.2	54.7	50.1	53.9	47.6	43.5	38.2	42.5	29.0	132.988
16764.5	57.8	57.8	58.4	57.9	60.9	58.3	58.1	54.8	49.7	53.9	47.4	43.5	38.6	43.1	28.8	134.016
16824.5	57.7	57.8	58.1	58.0	61.0	58.7	58.1	54.6	49.6	53.8	47.1	43.4	38.0	42.8	29.1	135.067
16884.5	57.7	57.5	58.1	57.8	60.6	58.2	58.2	54.5	49.6	53.7	47.2	43.3	38.0	42.4	28.9	136.096
16944.6	57.8	57.5	58.1	57.8	60.8	58.3	57.9	54.4	49.9	53.7	47.3	43.3	37.8	42.5	28.9	137.175
17004.6	57.7	57.7	58.1	57.6	60.7	58.3	57.9	54.4	49.2	53.7	47.1	43.1	38.3	42.5	28.8	138.217

APPENDIX B: SUMMARY OF SIGNIFICANT RESULTS

PHYSICAL PROPERTIES FROM DUNN AND REAY

TEMP=	Hfg=	T (C) =		DENSITY =		VISCOUSITY		SURFACE =	
10C	904.8		20.0	KG/M3	789.5	N-S/m2	1.26E-03	TENSION	0.0251
30C	888.6		40.0		771.5		8.60E-04	N/m	0.0238
50C	872.3		60.0		752.6		6.15E-04		0.0224
70C	858.3		80.0		734.2		4.40E-04		0.0211
90C	832.1								

Acx,1 (m2)	1.5806E-06	LATENT	898.70
Acx,2 (m2)	7.903E-07	HEAT	880.45
Acx,3 (m2)	1.7419E-06	J/kg	865.30
			845.20

THIS TABLE SHOWS THE SIGNIFICANT DATA FOR GROOVE #2

RUN DESIG	TIME,	T1 (C)	X,dryout(cm)	MDOTin gm/sec	MDOT,out gm/sec	Qliq (W)	UNCERTAINT (W)	Qplate (W)	Qliq/Qplate	Lt
G2E2	136.9	48.8	28.2	0.02813	0.0248	2.90	0.34	35.05	0.083	37.7
G2E2	237.8	47.4	28.8	0.02813	0.0253	2.47	0.34	35.17	0.070	38.4
G2E3	99.4	40.7	13.0	0.02813	0.0267	1.26	0.34	28.20	0.045	45.3
G2E4	245.5	34.2	0.0	0.02813	0.0250	2.78	0.34	15.15	0.184	51.8
G2E5	137.4	31.9	5.5	0.02813	0.0250	2.78	0.34	13.88	0.200	49.1
G2E5	246.0	78.1	40.0	0.02813	0.0220	5.18	0.33	98.29	0.053	31.8
G2E5	340.1	78.0	42.1	0.02813	0.0218	5.35	0.33	98.26	0.054	30.8

THIS TABLE SHOWS THE SIGNIFICANT DATA FOR GROOVE #3

RUN DESIG	TIME,	T1 (C)	X,dryout(cm)	MDOTin	MDOT,out	Qliq	UNCERTAINT	Qplate	Qliq/Qplate	Lt
G3E1	116.2	72.6	9.8	0.0698	0.0579	10.21	0.51	88.38	0.116	49.9
G3E2	154.3	71.0	0.0	0.0698	0.0547	12.98	0.51	84.11	0.154	54.8
G3E2	207.7	83.0 (T7 = 78.0)	33.3	0.0698	0.0525	14.62	0.50	110.04	0.133	38.2
G3E2	273.0	82.9 (T7 = 80.1)	33.0	0.0698	0.0523	.14.79	0.50	109.90	0.135	38.3

THIS TABLE SHOWS THE SIGNIFICANT DATA FOR GROOVE #1

RUN DESIG	TIME,	T1 (C)	X,dryout(cm)	MDOTin	MDOT,out	Qliq	UNCERTAINT	Qplate	Qliq/Qplate	Lt
G1E1	81.4	54.6	5.0	0.02813	0.0232	4.25	0.34	57.24	0.074	49.8
G1E3	121.4	58.4	18.0	0.02813	0.0188	8.04	0.33	57.88	0.139	43.3
G1E4	53.3	55.6	0.0	0.02813	0.0225	4.85	0.34	58.00	0.084	52.3
G1E4	154.3	78.4 (T6 = 79.7)	34.5	0.02813	0.0178	8.73	0.33	104.65	0.083	35.1
G1E4	229.2	78.3 (T6 = 79.1)	34.0	0.02813	0.0169	9.49	0.33	104.20	0.091	35.3

APPENDIX C: SUMMARY OF LIQUID FRONT MOVEMENT

GROOVE #1

		TIME,s	LOCATION,cm	VELOCITY,cm/s	ACCELERATION,cm/s2	T #	Tfront (C)	
G1E2		0.0	35	-	-		NA	
Qin (W) =	0	11.3	29	0.530	-		NA	
		24.6	23	0.461	-5.900E-03		NA	
		37.7	17	0.458	4.907E-04		NA	
		50.1	13	0.325	-1.080E-02		NA	
		63.4	9	0.301	-1.841E-03		NA	
		76.4	5	0.307	4.900E-04		NA	
		92.2	1	0.253	-3.400E-03		NA	
Vave			0.2765	0.375				
STAN DEV				0.104			Tfront (C)	
		TIME,s	LOCATION,cm	VELOCITY,cm/s	ACCELERATION,cm/s2	T#	0.0	
G1E4		0.0	34.5	-	-	NA	0.0	
Qout/Qs=0		168.4	28.0	0.038	-	T7	70.1	
		622.8	23.0	0.013	-4.300E-05	T6	68.4	
		742.0	17.0	0.050	3.120E-04	T5	65.7	
		784.3	13.0	0.095	1.040E-03	NA	0.0	
		822.8	9.0	0.104	2.480E-04	T3	68.0	
		857.8	5.0	0.114	2.900E-04	T2	63.6	
		910.3	1.0	0.085	-8.007E-04	T1	82.3	
Vave			0.0375	0.068				
				0.030				

		TIME,s	LOCATION,cm	VELOCITY,cm/s	ACCELERATION,cm/s2	T #	Tfront (C)	
G1E4								0
Qout/Qs=1		0.0	34.0	-	-	NA	NA	0
		284.0	28.0	0.020	-	T7	70.7	70.7
		1680.2	23.0	0.004	-1.000E-05	T6	61.4	61.4
		2318.6	17.0	0.009	8.100E-06	T5	58.4	58.4
		[illegible]	16.0	0.007	-8.440E-06	T5	66.5	0
		2738.4	13.0	0.016	9.390E-05	NA	NA	57.5
		2894.5	11.0	0.005	-3.600E-05	NA	NA	58
		3114.7	9.0	0.016	5.900E-05	T3	57.5	0
		[illegible]	7.0	0.005	-2.941E-05	T3	NA	
		[illegible]	5.0	0.004	-9.100E-06	T2	NA	
		4467.2	3.7	0.002	-3.400E-05	T2	80.0	
Vave			0.0068	0.009				
				0.006				

GROOVE #2

		TIME,s	LOCATION,cm	VELOCITY,cm/s	ACCELERATION,cm/s2	T #	Tfront (C)
G2E6		0.0	22	-	-		NA
Qin (W) =	0	8.8	20	0.227	-		NA
		17.9	18	0.220	-8.294E-04		NA
		26.8	16	0.225	5.840E-04		NA
		36.8	14	0.200	-2.472E-03		NA
		46.5	12	0.208	8.377E-04		NA
		57.3	10	0.185	-1.900E-03		NA
		78.3	8	0.164	-2.411E-03		NA
		81.6	6	0.177	2.045E-03		NA
		93.6	4	0.167	-8.804E-04		NA
		105.7	2	0.165	-1.100E-04		NA
		118.4	0	0.157	-8.140E-04		NA
Vave			0.1665	0.168			
				0.027			
G2E2		0.0	28	-	-	T7	45.1
Qout/Qs=0		138.0	26	0.014	-		
		245.0	24	0.019	3.720E-05		
		300.0	22	0.036	6.280E-05	T6	38.3
		350.0	20	0.035	8.840E-04		
		414.0	18	0.012	-2.804E-04		
		452.0	16	0.048	1.417E-04	T5	38.2
		554.0	14	0.035	-2.046E-04		
		640.0	12	0.030	-7.100E-05	T4	37.2
		810.0	10	0.012	-3.200E-05		
		886.0	8	0.016	2.700E-05	T3	34.9
		1044.0	6	0.010	2.400E-05		
		1102.0	4	0.014	-2.917E-05	T2	32.6
		1204.0	2	0.020	6.040E-05		
		1352.0	0	0.042	4.000E-04	T1	31.7
Vave			0.0210	0.020			
				0.014			

G2E2	0.0	24	-	-			
Qout/Qc=0	120.0	22	0.017	-	T6	40.5	
	270.0	20	0.013	-2.222E-05			
	336.0	18	0.030	2.571E-04			
	420.0	16	0.024	-7.730E-05	T5	37.7	
	546.0	14	0.016	-6.298E-05			
	636.0	12	0.022	7.056E-05	T4	35.3	
	714.0	10	0.026	4.363E-05			
	810.0	8	0.021	-5.008E-05	T3	34.1	
	900.0	6	0.022	1.543E-05			
	1014.0	4	0.018	-4.104E-05	T2	32.3	
	1104.0	2	0.022	5.198E-05			
	1176.0	0	0.028	7.716E-05	T1	31.7	
			0.022				
			0.006				
G2E3	0.0	12	-	-	T4	40.5	
Qout/Qc=0	256.0	10	0.008	-			
	402.0	8	0.014	4.282E-05	T3	36.4	
	516.0	5.4	0.023	7.823E-05			
	570.0	3.5	0.035	2.292E-04	T2	34.4	
	618.0	2	0.031	-8.198E-05			
	684.0	0	0.030	-1.435E-05	T1	33.7	
Vave		0.0175	0.024				
			0.011				
G2E5	0.0	40	-	-	T9	82.0	
Qout/Qc=0	90.0	38	0.022	-			
	204.0	36	0.018	-4.104E-05			
	294.0	34	0.022	5.198E-05	T8	58.2	
	378.0	32	0.024	1.890E-05			
	468.0	30	0.022	-1.764E-05			
	564.0	28	0.021	-1.447E-05	T7	39.5	
	642.0	26	0.028	6.164E-05			
	738.0	24	0.021	-5.008E-05			
	792.0	22	0.037	3.001E-04	T6	47.0	
	864.0	20	0.028	-1.288E-04			
	954.0	18	0.022	-8.173E-05			
	1044.0	16	0.022	0.000E+00	T5	43.5	
	1152.0	14	0.019	-3.428E-05			
	1236.0	12	0.024	6.298E-05	T4	39.5	
	1332.0	10	0.021	-3.100E-05			
	1392.0	8	0.033	2.083E-04	T3	38.0	
	1446.0	6	0.037	6.858E-05			
	1524.0	4	0.038	-1.461E-04	T2	38.0	
	1602.0	2	0.028	0.000E+00			
	1644.0	0	0.048	5.233E-04	T1	35.8	
Vave		0.0243	0.028				
			0.007				
G2E5	0.0	40	-	-	T9	63.3	63.3
Qout/Qc=1	128.0	38	0.016	-			57.4
	240.0	36	0.018	1.488E-05			53
	354.0	34	0.018	0.000E+00	T8	57.4	49.6
	468.0	32	0.030	2.084E-05			46
	612.0	30	0.013	-4.351E-05			41.4
	738.0	28	0.016	2.423E-05	T7	53.0	38.8
	846.0	26	0.030	3.888E-05			37.1
	948.0	24	0.019	-1.008E-05			37
	1080.0	22	0.030	1.288E-04	T6	49.6	
	1134.0	20	0.018	-8.977E-05			
	1248.0	18	0.016	0.000E+00			
	1368.0	16	0.017	-7.310E-06	T5	46.0	
	1518.0	14	0.013	-2.288E-05			
	1668.0	12	0.014	8.408E-06	T4	41.4	
	1812.0	10	0.013	-1.072E-05			
	1962.0	8	0.013	3.419E-06	T3	38.8	
	2160.0	6	0.019	-1.632E-05			
	2400.0	4	0.030	-7.385E-06	T2	37.1	
	2508.0	2	0.019	9.431E-05			
	2640.0	0	0.015	-2.551E-05	T1	37.0	
Vave		0.0152	0.016				
			0.004				

GROOVE #3

		TIME,s	LOCATION,cm	VELOCITY,cm/s	ACCELERATION,cm/s2		Tfront (C)	
G3E4		0.0	32	-	-		NA	
Qin =	0	4.4	30	0.460	-		NA	
		11.1	28	0.589	1.906E-02		NA	
		15.2	24	0.498	-2.278E-02		NA	
		23.5	20	0.479	-2.212E-03		NA	
		31.8	16	0.463	4.182E-04		NA	
		38.0	14	0.474	-2.032E-03		NA	
		50.0	8	0.429	-3.221E-03		NA	
		62.7	2	0.472	3.430E-03		NA	
		75.4	0	0.156	-2.481E-02		NA	
			0.4244	0.449				
				0.118				
G3E1		0.0	10	-	-			
Qout/Qc=0		96.0	8	0.021	-	T2	71.5	
		120.0	6	0.083	2.604E-03			
		138.0	4	0.111	1.543E-03	T1	70.2	
		150.0	2	0.167	4.630E-03			
		168.0	0	0.111	-3.086E-03	T0	69.8	
			0.0595	0.089				
				0.083				
G3E2		0.0	31	-	-	T7	79.6	
Qout/Qc=0		96.0	28	0.052	-	T6	81.5	
		120.0	22	0.167	4.774E-03			
		174.0	16	0.111	-1.029E-03	T4	80.6	
		198.0	14	0.083	-1.157E-03			
		222.0	12	0.083	0.000E+00	T3	77.9	
		246.0	10	0.083	0.000E+00			
		264.0	8	0.111	1.543E-03	T2	75.7	
		294.0	6	0.067	-1.481E-03			
		312.0	4	0.111	2.469E-03	T1	73.2	
		327.0	2	0.133	1.481E-03			
		354.0	0	0.074	-2.195E-03	T0	71.3	
			0.0678	0.089				
				0.033				
G3E2		0.0	33	-	-			
Qout/Qc=1		42.0	31	0.048	-	T7	80.0	0
		90.0	30	0.021	-5.580E-04			0
		114.0	28	0.083	2.604E-03			80
		132.0	26	0.111	1.543E-03	T6	81.9	81.9
		180.0	24	0.042	-1.447E-03			0
		216.0	22	0.056	3.858E-04			79
		264.0	20	0.042	-2.894E-04			77.9
		342.0	18	0.026	-2.058E-04			74.8
		420.0	16	0.026	0.000E+00	T4	78.0	71.8
		528.0	14	0.019	-6.598E-05			
		648.0	12	0.017	-1.543E-05	T3	77.9	
		810.0	10	0.012	-2.667E-05			
		984.0	8	0.011	-4.893E-06	T2	74.8	
		1146.0	6	0.012	5.256E-06			
		1308.0	4	0.012	0.000E+00	T1	71.8	
		1602.0	2	0.007	-1.865E-05			
		1908.0	0	0.007	-8.716E-07	T0	68.0	
			0.0173	0.032				
				0.009				

APPENDIX D: REYNOLDS ANALOGY CALCULATION
THE PURPOSE OF THIS PROGRAM IS TO INFER THE EVAPORATION
RATE FROM THE HEAT TRANSFER COEFFICIENT
USING THE DATA FROM RUNG2E4 AND PROPERTY DATA
FROM INCROPERA AND DEWITT
hc,ave is from data; hc,theo is from McAdam for
hot horizontal plate

T,evap (C)	34.2	Tsur (C)	22
thdif (m2/S)	2.34E-05		2.18E-05
k (W/m K)	0.0267		0.0259
Dens,AIR	1141.4	g/m3	1184.73
Cp (J/g K)	1.007		1.007
Dab (m2/s)	1.238E-05		1.172E-05
Le	1.8901454		1.86006826
hc, ave(W/m2 K)	14.54		14.54
hc, THEO	5.133		5.133
p,vap (N/m2)	13373.6		6783.4
L,evap	0.511	m	0.251
W,evap	1.40E-03	m	0.000689
Mm	46	gm/gmole	46
hfg	886.2		895.06
Rho,vap (gm/m3)	1440.0000		1440.0000
hm,ave (m/s)	0.0063		0.0061
hm,theo	0.0029		0.0028
EVAP (kg/s)	0.0065	Na using hc,ave	0.0026
	0.0030	Na using hc,theo	0.0009
Q,evap (W)	7.5336	using hc,ave	2.3171
	2.6596	usinghc,theo	0.8180

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VITA

Captain Timothy J. Murphy was born 30 March 1956 in Chicago, Illinois. After graduating from St. Ignatius College Preparatory in San Francisco, he entered the College of Mechanical Engineering at Marquette University in Milwaukee, Wisconsin. He received a Bachelor of Science in mechanical engineering, and stayed at Marquette to acquire a Master's degree in mechanical engineering. His master's project was a computer simulation of the performance of high temperature zirconia oxide fuel cells operated with hydrogen. He entered the doctoral program in mechanical engineering at the University of California at Berkeley where he worked on basic heat transfer research on air fluidized coal particle beds. He left there in 1984. Captain Murphy was commissioned from Officer Training School in July of 1986, and reported to his first duty station at the Ballistic Missile Office (BMO), Norton Air Force Base, California. His duty title there was Nuclear Hardness and Survivability Project Manager which included directing tests and analysis to ensure nuclear survivability was incorporated into the designs of the Peacekeeper in Minuteman Silos and Rail Garrison ICBM weapon systems. During his last year at BMO, Captain Murphy served as executive officer to both the Director of Engineering for

Rail Garrison and the Program Manager for the Minuteman System Program Office. He served in this capacity until entering AFIT in the Astronautical Engineering Master's Program in May of 1990. Captain Murphy's lovely wife is named Maria.

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This is an experimental study of ethanol flowing in the narrow grooves of a copper plate which is subjected to heat fluxes sufficient to evaporate more liquid than can be replaced by capillary pumping. Three groove geometries are used: square, rectangle, and trapezoid. The objective is to simulate aspects of liquid flow in heat pipes with axial grooves. In order to validate analytical models of capillary flow in grooves, the capillary limit, dryout front location, and dryout front movement in response to power draw downs are documented.

The results show the rewet performance of the groove is dependent on geometry. Grooves of higher heat transfer capacity can be poor for recovering from dryout, like the trapezoidal groove. Comparisons of the theoretical maximum heat transfer with the data are good for the square and rectangle, but overestimate the value for the trapezoid. No theory sufficiently predicted the location of the dryout front for the three geometries. For both a quiescent dryout front and a boiling dryout front, the theory does not utilize an accurate description of the geometry of the liquid front which is critical for determining the capillary pressure difference.

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